SCIENTIFIC AMERICAN

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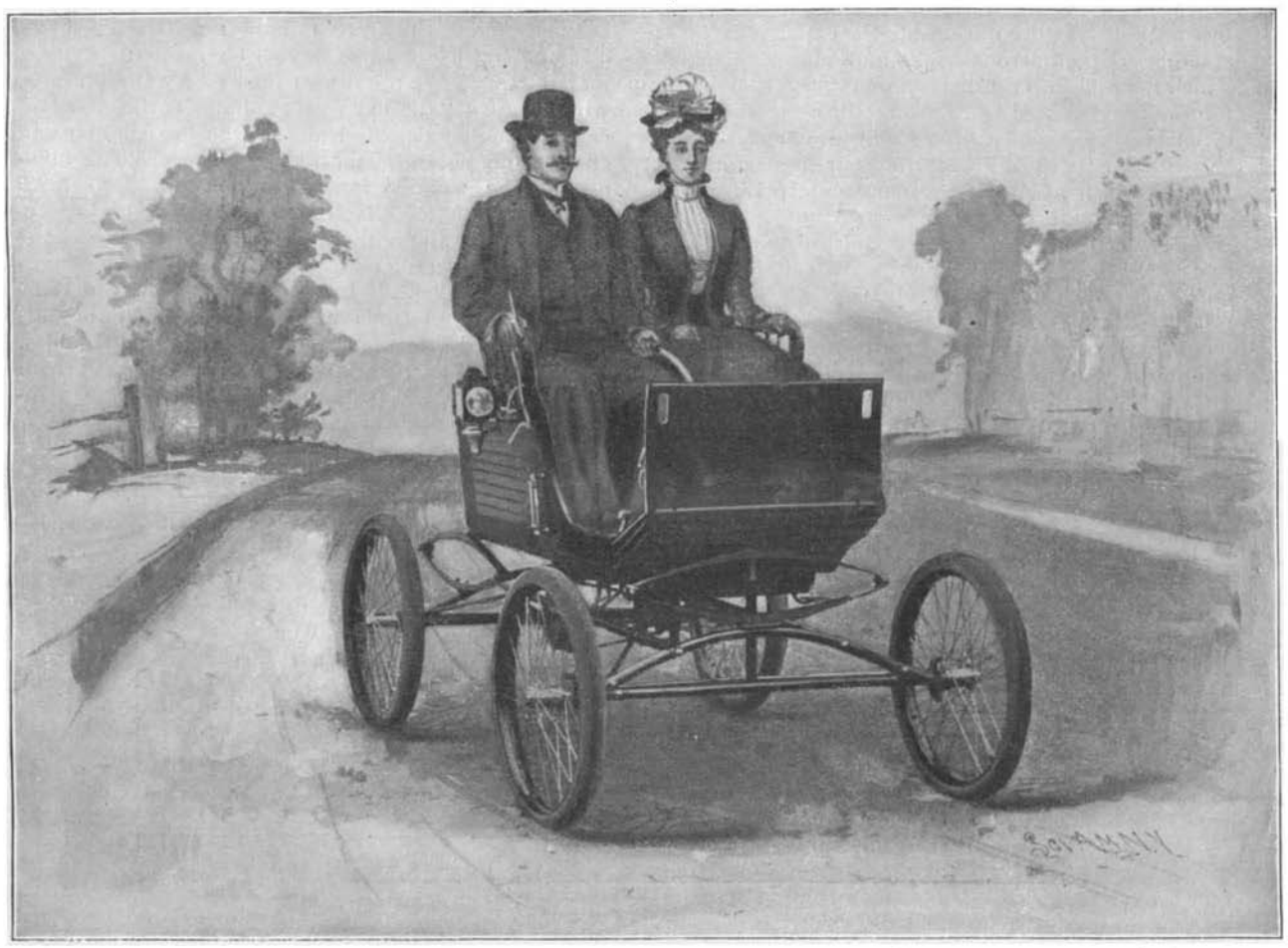

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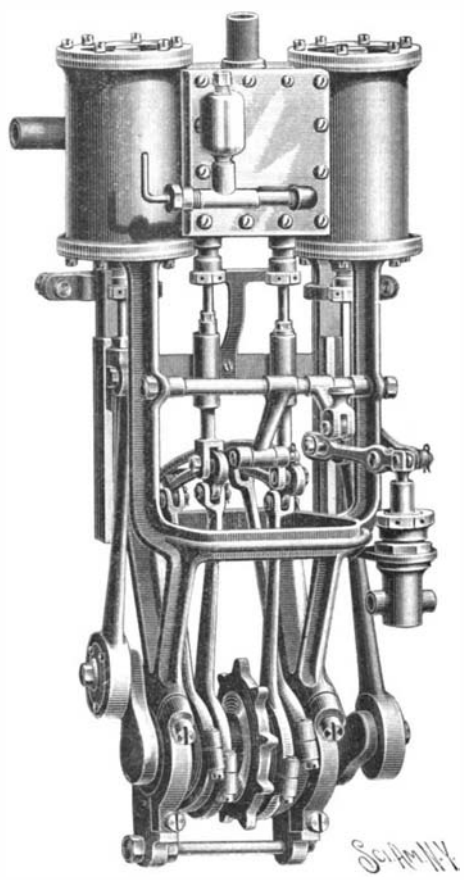
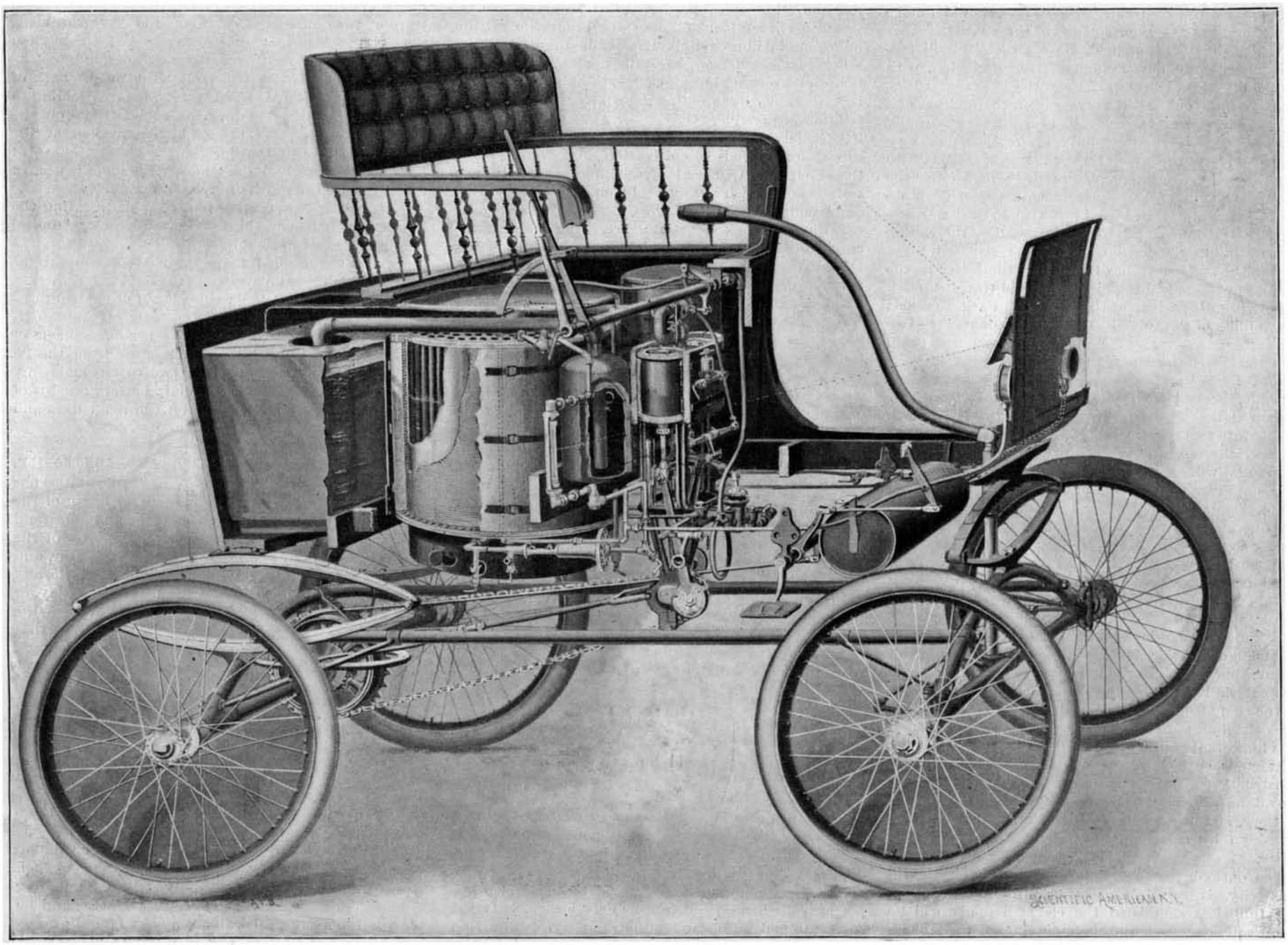
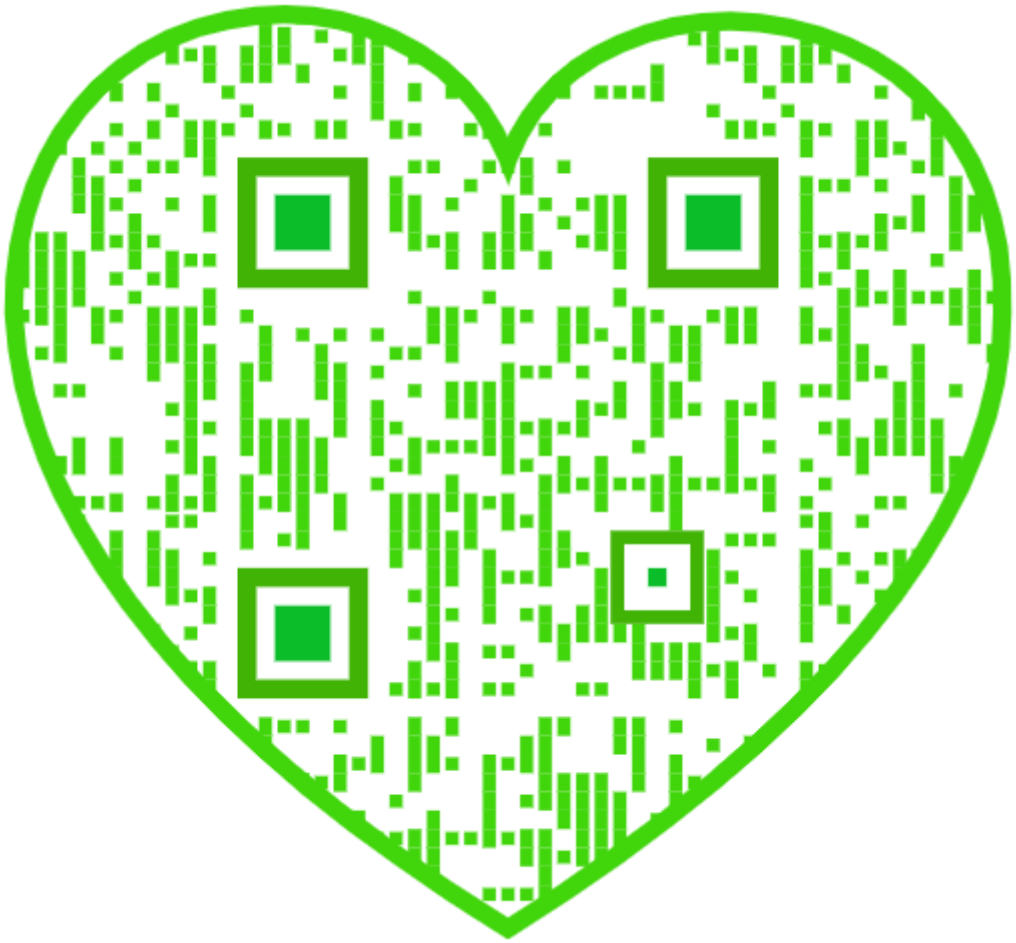


THE 4-HORSE POWER ENGINE.



THE "LOCOMOBILE"—SECTIONAL VIEW, SHOWING LOCATION OF ENGINE, BOILER, AND TANKS.—[See page 54.]



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NEW YORK, SATURDAY, JANUARY 27, 1900.

A NEW ERA IN CITY TRANSPORTATION.

The gentlemen comprising the Board of Rapid Transit Commissioners of the city of New York have at length achieved the formidable task of devising a suitable plan of rapid transit and securing a contractor who was able and willing to undertake the construction for a sum that would not exceed the constitutional limit of the city's indebtedness.

The amount of the successful bid, $35,000,000, is a vindication of the estimates of William B. Parsons, the chief engineer of the commission, whose estimate of $35,000,000 was made before the present rise in the price of steel and the passage of the eight-hour labor law,—modifying factors which must have entered largely into the estimates of the successful bidder.

The fact that the road is to be built by John B. McDonald has given general satisfaction, mainly for the reason that he has already had wide experience in the construction of heavy engineering works which are more or less of the character of the Rapid Transit Tunnel. He constructed the celebrated Belt Line Tunnel in Baltimore, and is now engaged in building to the north of this city the large artificial basin known as Jerome Park Reservoir, a task involving the excavation of over six million cubic yards of material, of which the greater proportion is rock. It is the intention of the contractor to sublet the tunnel in several sections and open up work simultaneously along the whole length of the line. If this is done, we see no reason why the contract, great as it is, should not be completed in the estimated time of three years.

When the road is opened, New York city will possess an entirely new system of transportation, with a capacity second only to that of the elevated roads, and superior to all existing systems in the number and speed of its express trains. It will furnish an essentially long-distance service, the bulk of its trains making stops only at the more important stations. It will thus assist in effecting a much needed separation of the enormous volume of passenger traffic that flows up and down Manhattan Island into two distinct classes—the short-distance and the long-distance, the former gravitating to the local trains of the elevated roads and to the surface trolley roads, and the latter to the elevated express trains and to the rapid transit tunnel.

Starting with a loop at the City Hall Park, the first seven miles of the tunnel will contain four tracks—two for express and two for local trains. This portion will lie either beneath or close to the main arteries of street traffic, following the route of Elm Street, Fourth Avenue, Forty-second Street, and Broadway to One Hundred and Fourth Street, where the system will divide into two two-track lines. One of these will bear to the right beneath the northwest corner of Central Park, and will extend beneath Lenox Avenue and the Harlem River to Westchester Avenue and the Bronx Park. The other will be carried beneath Eleventh Avenue and by way of the Kingsbridge Road to a terminus on the Harlem River near Spuyten Duyvil.

The route as thus laid out and forthwith to be built will be extended, no doubt, in the near future. As it stands, the most serious defect is that it stops short of the important section of the city lying between the City Hall and the Battery. The original plans of the commission contemplated a terminus at the latter place; but the bitter opposition of the owners of property in lower Broadway, coupled with the desire of the commission to keep the estimated cost within the debt limit of the city, led to the abandonment of this important section of the original plans. We think that steps should be taken at once looking to the construction of this portion of the tunnel, the removal of the loop from the City Hall Park to the Battery, and the ultimate extension of the road to Brooklyn by means of a tunnel beneath the East River.

The outlook for future transportation facilities in this city is certainly very bright. By the time the tunnel is completed the elevated roads will be electrically operated, and the main lines of the Metropolitan and Third Avenue surface roads will be similarly equipped. To this must be added the undoubted effect of the large service of automobile cabs and buses that is promised in the near future.

THE AGRICULTURAL OUTLOOK IN PUERTO RICO.

At present very little in the way of plant products is exported from Puerto Rico outside of coffee, sugar, and tobacco. All other crops are considered unworthy of the serious attention of the planters, their cultivation being generally left to the desultory efforts of the most ignorant of the population. There has been little attempt at the improvement of varieties, either by selection or by the introduction of superior seed. Much of the fruit and vegetables sold is of a very inferior quality, quite unsuitable for export. Notwithstanding the numerous books and magazine articles which have been published, there is very little definite information available concerning the agricultural conditions and economic plants of that island.

It having been decided that our Department of Agriculture should assist the more enterprising farmers, both Americans and Puerto Ricans, in experiments, which many of them have already undertaken, in order to find out what new crops suitable for our markets can be grown there, Mr. O. F. Cook was sent, as a Special Agent, by Secretary Wilson to ascertain what species and varieties are now to be found there, in order that the department might be able to secure others likely to be of use in improving and extending the agricultural industries. Mr. Cook has just made his preliminary report.

We are paying over $200,000,000 for tropical plant products, a large part of which could be furnished by Puerto Rico and the Philippines. For bananas, for instance, we paid in 1898 over $5,500,000, mostly to Jamaica and Central America. In Puerto Rico the banana has scarcely been considered as an article of export. It has been planted principally for shade in the coffee plantations, and is of unsalable quality. The variety almost exclusively imported into the United States is not generally cultivated. As the conditions for commercial banana growing are very favorable, it may be expected that attempts in this direction will soon be made.

The soil and climatic conditions are exceedingly diverse; it is probable that a wide range of products can be secured, at least for local consumption. Oranges, limes, and other citrus fruits, European grapes, and other semi-tropical fruits and vegetables can be produced in the drier parts of the island; while from the moister parts vanilla, cacao, mangoes, and other more strictly tropical plants can be exported. In the meantime it is of great importance that the existing industries be improved. Sugar lands are receiving attention from American capitalists, and large modern factories are being built. Coffee, the chief product of the island, is perhaps that in which the greatest expansion is possible. Over $13,000,000 worth of coffee has been exported in a single season from Puerto Rico in spite of methods of cultivation of the most primitive character. Instead of seedlings grown in nurseries, those which spring up by chance, already weak and spindling, are used. This, together with the overcrowding and lack of proper care, brings the average crop down to one-third or less of what might be obtained through better methods. There is a large amount of land suitable for coffee culture, not now planted. If this industry were properly developed, Puerto Rico might supply quite half of the enormous quantity consumed by the United States, our imports in 1898 being valued at over $65,000,000.

The fact that Puerto Rico contains no large unoccupied areas has led some observers to represent the entire island as thickly populated. This is not the case; while a large part of the available land has been at some time under cultivation, there are many districts in which not more than 10 per cent of it is now in use, except for stock raising, which may properly be called the most popular agricultural industry at the present time. For men without capital or experience in the industries of tropical countries, there are no openings in Puerto Rico. Puerto Rico is unique among the West Indies in the possession of a large white population capable of furnishing labor for carrying out local improvements and of taking part in advancing civilization. This is because of the delightful climate, where the European can live, work, and thrive. A more advantageous point of contact with the tropics could scarcely have been selected.

"TIME IS MONEY."

The meetings held in connection with the recent International Commercial Congress at Philadelphia, dealt very freely with the questions of the methods employed by manufacturers in Europe and in the United States, and one of the most practical and useful among the many papers bearing more or less directly on this question was read by Mr. W. C. Barker, of New York. While it is impossible to review at any length the whole paper, we draw attention to an important distinction made by Mr. Barker between American and European methods in striving to arrive at the same ultimate economy. It seemed to the speaker, as the result of his observations abroad, that the European manufacturers lay it down as a cardinal principle that "time" is of no value, sacrificing "time" to save outlay in new and improved plant. They employ old machines, tools, etc., and speed their machines to suit the movement of the poorly paid workmen. The American manufacturers proceed on the principle that "time is money," and, therefore, they spend money freely to save time. They do not hesitate to buy the most improved machines to replace their existing plant from time to time, and they speed up their machines so as to turn out the greatest possible amount of work, and employ the best men that money can buy to operate them.

As a concrete illustration of these two diverse methods, the speaker told of a visit he made to a large manufactory of agricultural machinery in Europe, where he saw "the old single-spindle boring machinery and the single-chisel mortise, boring one hole and cutting one side of a mortise at a time." The manager of the works was "greatly surprised to learn that American manufacturers used gang boring-machines, boring all parallel holes through a piece at one movement, and gang mortisers cutting all parallel mortises at one stroke." In the floor room of the same factory he found them using a rope and pulley attached to a drop-hammer running in upright guides, the machine being worked by hauling the hammer up by hand and allowing it to fall. This was their trip-hammer. The statement that in America power hammers were used, striking 100 to 150 blows per minute, produced positive astonishment.

At the same time the manager of the works seems to have been perfectly well aware of the true key to the difference between methods in the old and in the new worlds, attributing the conservatism of the European manufacturer and his workmen to the influence of tradition and environment, whereas the invention and mechanical genius of the average American was considered to be the outcome of the fact that his ancestors found themselves surrounded with new conditions that required new methods of thought and action, while "their descendants have each kept on thinking out new ways and methods of doing things ever since."

A WISE DECISION.

At the last meeting of the Naval Board of Construction the various plans which have been drawn up for the armament of the new battleships of the "New Jersey" type were under consideration, and the main question debated was that of the installation on these ships of the double-decked or superposed turret. The SCIENTIFIC AMERICAN has always urged the wisdom of awaiting the results of the forthcoming gunnery trials of the "Kearsarge" and "Kentucky," both of which carry the superposed turrets, before deciding to use this much debated form of construction on the new battleships. We are glad to note that at the meeting referred to it was decided to await the tests of the "Kearsarge," and only adopt the double-decked turret in case the results were satisfactory.

Of the several alternative plans for distributing the armament of the new ships presented by Rear-Admiral O'Neil, most of which have been described in this journal, it was decided to adopt that one known as type A, which was illustrated in the SCIENTIFIC AMERICAN of September 9, 1899; this plan of armament to be followed only in the event of the tests of the "Kearsarge" being unsatisfactory. The type A scheme of redistribution removes the 8-inch guns from the 13-inch turrets and places them in two turrets amidship, one on either beam. The secondary battery consists of ten 6-inch rifles in broadside on the main deck and four 6-inch rifles on the superstructure.

COMPARATIVE COST OF HORSE AND AUTOMOBILE.

A village resident in one of the English counties has communicated to a local journal an estimate of the relative cost of keeping an automobile and horse and carriage. He arrives at an economy in favor of the motor of $47.75 on the total expenses for the year, and he does it thuswise: The cost of the horse is $115, and of the dog-cart $135; the interest on which outlay, at 4½ per cent for one year, is $11.25; the keep of the horse, at $2.50 a week (it must be remembered that these prices are for keep in a country village), and license and shoeing, bring up the total expense for the year to $159. This he compares with a five-horse power automobile costing $850, the interest on which, at 4½ per cent for the year, is $38.25. Adding to this a tax of $21 and expense of $52 for fuel (petrol in this case), at the rate of 75 cents for 35 miles, and 25 cents for the same distance for lubrication, he reaches a total annual expense of $111.25.

It will be noticed that in the above estimate there is no repairs account, an item which we think the average unskilled automobilist of the future will find to be, perhaps, the most serious of all, outside of fuel. In this case, however, the automobilist was something of a mechanic, possessing a lathe, a vise, etc., and he was equal to making all ordinary repairs himself; moreover, he argues that in any case the accidents that

may happen to a horse, and the more or less frequent visits of the veterinary, will fairly well offset repairs to the automobile.

Just here we would suggest that in view of the fact that the mechanism of the automobile is necessarily complex, and in many forms of motor susceptible to easy disarrangement, it would be well for all intending purchasers to acquire some elementary knowledge of the simpler tools of the mechanic; and we think it is not unlikely that the coming rage for automobilism, which, unlike that for the bicycle, will prove to be lasting, will give an added impetus to the study of practical mechanics in our schools and colleges. In any case the business of automobile repairing will be one of the most important and profitable of the new industries of the future.

INJECTION OF WOOD.

According to the Russian savant, M. Philopoff, the product used for the injection of wood should fulfill the following conditions: It should be an energetic antiseptic and should not cause a deterioration of the wood. It should be easily injected, fixing itself in the pores of the wood, so that it will not be driven out by humidity. It should form in the wood stable chemical compounds, and should be dialyzable, so as to easily penetrate the tissues. A great number of substances have been proposed for the injection of wood, but none of these have as yet responded completely to the above conditions and given results which are entirely satisfactory. Naphtha, among others, has not realized the hopes which were expected. It does not penetrate the wood entirely, however great the pressure, and besides it has been demonstrated that it does not prevent the development of the bacillus amylobacter. A number of Russian chemists have experimented in this direction, as naphtha and its derivatives are abundant in the petroleum regions of the Caucasus. One of these, M. Karitchkoff, appears to have arrived at a solution of the problem by using the organic acids which are found in the crude naphtha, and which, after the rectification of petroleum by caustic soda, remain in combination with the latter, forming various salts of these acids. It has been found that these substances act as a powerful preservative of wood against putrefaction. In 1862, in fact, Wagner had observed the antiseptic nature of several of the fatty acids and made experiments with oleate of aluminium, of copper, etc., for the preservation of wood. In these he was quite successful, but the cost of the method prevented it from coming into practical use. The process of M. Karitchkoff has been received with favor, as the price of the acids derived from naphtha is very low. They may be considered as deriving from the hydrocarbons of the naphthene group, and are yellow, oily liquids, insoluble in water, and form acid or neutral salts. Of these, the acid salts and the neutral salts of the heavy metals are soluble in hydrocarbon liquids. The experimenter has studied in detail the antiseptic properties of these products, and from certain observations concludes that the acids are more powerful than the salts. Of the latter, the copper salts are the most energetic. In experiments upon organisms which attack the wood and cause decomposition, such as the polyporus sulfureus, the injected pieces of wood, kept in water, were still intact at the end of eight months, while the samples not injected were attacked by the parasites in a few days. Thus their antiseptic properties are beyond question. But as the pure acids do not fix so well in the wood, the use of the salts is, on the whole, preferable. The copper salt may be prepared in two different operations; first, by the reaction of the organic acid upon pieces of the metal, or, secondly, by double decomposition of the sodium salt with copper sulphate; the latter process is the most rapid.

It remained, however, to find a solvent for the naphthenic salts, as they are insoluble in water. The experimenter has found a good solvent in another product of the distillation of naphtha, namely, ligroine; this product dissolves easily the naphthenic acid and salts. Its great inflammability is the only objection to its use. The operation of injecting railroad ties, as carried out by M. Karitchkoff, is as follows: The ties are dried in special driers, then the injection is made in cylinders adapted for the purpose. As the ligroine penetrates easily, a pressure of four atmospheres is sufficient. The solvent is then eliminated by evaporation in a current of hot air. Each tie requires about 1½ pounds of antiseptic, and the cost of injecting a tie is estimated at $0.10.

THE PAN-AMERICAN EXPOSITION OF 1901.

It is now eighteen months before the Pan-American Exposition at Buffalo will open its gates to the coming flow of visitors, and all will surely be surprised to see what has been accomplished in so short a time. Within a few months the Pan-American Exposition Company has secured large appropriations and subscriptions, which have enabled the fair to be put upon a solid basis. New York State has appropriated $800,000. It is now assured that the countries of South and Central America will make large appropriations and will erect splendid buildings. It was first proposed to have the Exposition in 1899, but the Spanish-American war caused a change in plan, with the result that the whole scheme has greatly broadened and increased. The selected tract of land which the buildings will occupy embraces about 335 acres of the finest section of the city, 180 acres being the show portion of Delaware Park, the handsomest subdivision of Buffalo's very complete and handsome park system. To reach this ideal spot it is necessary to traverse the finest residential section of the city, which is noted far and wide for the beauty of its homes and the magnificence of its avenues and boulevards. Some idea of what is being done can be obtained by reference to the current number of the SUPPLEMENT, which contains four large illustrations showing Machinery and Transportation, Graphic Arts and Forestry Buildings, and also the Plaza. For architectural splendor it will bear favorable comparison with the Chicago Exposition of 1893.

THE RISKS OF WAR.

England's losses in South Africa are large compared with very recent wars, because there has been no great struggle between two civilized nations since the Franco-German war, and in fighting with half civilized peoples the percentages of loss have invariably been all one way—in favor of the modern equipped armies. Even in our short war with Spain, which was not a stubbornly-contested conflict, the importance of modern military tactics and scientific inventions could not be fairly estimated. The equipment of the English army with all modern destructive agencies to meet a stubborn foe almost equally well provided with powerful weapons will furnish sufficient data for some very interesting military literature when the battles have all been fought.

The risks of war have never been quite so great as the inventors of the weapons would lead us to believe. The climate in many wars has been a far greater enemy than the bullets and cold steel of the soldiers. Recent statistics show that the number of our soldiers killed in battle in the Philippines in the last four months of the old year was only 361, and the number who died from wounds and accidents 200, while those who died of disease were 762. In the Cuban campaign the deadly work of the climate was even more effective in its results. The large life insurance companies recognize the risks of the climate as equal to those of exposure to the bullets of the enemy, and special clauses are attached to many policies which specify that officers sent to Cuba or the Philippine Islands must have their policies reconsidered, and an extra fee paid.

An interesting item of fact is gleaned from the Crimean war literature, that is further verified by some of the naval battles of our recent war. The Russian forces fired 45,000,000 rounds of shots and killed 48,000 men, or one soldier to every 910 shots fired. It was estimated that only a few shots in every hundred of our naval guns hit the mark, and this fact was used as an argument in favor of discarding the heavier guns and substituting smaller and rapid-firing guns.

Since the Crimean war the rapid-firing guns have greatly increased the efficiency of the artillery and infantry, and the number of shots that can be fired in a given time has multiplied several times over. But the number of fatal wounds inflicted by the modern small bullets has decreased. In the Cuban war about 99 out of every 118 American soldiers shot made complete recoveries. The employment of the modern high-power rifles with their small bullets tends to put more soldiers out of the fight temporarily, but actually decreases the mortality. A queer aspect of the investigation was that a majority of the bullets found lodgment, not in the trunk of the body, but in the arms, legs, and head. The proportion in the Spanish-American war was forty in the legs, thirty in the arms, twenty in the body, and ten in the head and neck, out of every hundred bullets that hit a human target.

The percentages of loss in the South African battles have not been very great, as statistics tend to show. In the fierce battles of the War of the Rebellion the percentage of loss of either side approached in some instances one-half the total strength of the contending armies. General Hancock's loss at Fredericksburg was estimated at about 50 per cent, General Longstreet's at Gaines Mill at 50 per cent, and in some half a hundred other battles the percentage of loss ranged between 16 and 18 per cent. Few battles in the world's history can show heavier losses or more stubbornly contested conflicts than the leading engagements of the Rebellion. Even at famous Balaklava the immortalized Light Brigade lost only 37 per cent, and at Metz the famous Gardeschützen lost 46 per cent. Even in the loss of officers the English in South Africa have not made new history. In the Franco-German war, the Germans lost at Spicheren, when they had stormed the French positions, 223 officers and 4,871 men. In the Peninsular war, at the siege of Ciudad Rodrigo, the loss in one desperate charge was 1,200 men and 90 officers, and when the British assaulted Badajoz over 60 officers were lost and a large number wounded, out of a total fighting force of 18,000. At San Sebastian the British lost in the final assault on the fortress 1,716 men and officers, the latter numbering over 150. In one battalion at Salamanca 24 officers were killed and wounded, leaving only three officers untouched by the bullets of the enemy after the fight.

DEATH OF PROFESSOR EGLESTON.

Thomas Egleston, LL.D., founder of the School of Mines of Columbia University, and for thirty-three years professor of mineralogy and metallurgy in this school, died January 15, at his residence in New York city. He came of New England stock, and was born in 1832. He graduated from Yale University in 1854, after taking a course in chemistry. He then went abroad and studied geology and chemistry in Paris, and graduated from the French School of Mines with honor in 1860. In 1861 he returned to the United States, and was appointed director of the mineralogical collections and laboratory at the Smithsonian Institution, Washington. There was at that time no institution in the country in which mining and metallurgy was taught as a main subject. He aroused the interest of the president of Columbia College, and a short time afterward the school was started in the old college building in Forty-ninth Street, Mr. Egleston being made professor.

The influence of the school has been felt in all parts of the country and it is one of the best scientific schools of the world. He was also one of the founders of the American Institute of Mining Engineers, and was one of its presidents. He was a member of many learned societies and has occupied important positions of trust. He was an officer of the French Legion of Honor. He was a prolific writer upon his chosen specialty, and he withdrew from the active work of the school some two years ago. He was held in high esteem by his old students, and we are sure there will be much grief experienced over his death.

POSSIBLE FEDERAL PROTECTION OF BIRDS.

Senator Hoar of Massachusetts has introduced a bill into the Senate of the United States, which, if it becomes a law, will prohibit the importation into the United States of birds, feathers or parts of birds for ornamental purposes, but birds for food and for museums, zoological gardens or scientific collections, are permitted to be imported, as well as living birds, whose feathers can be removed, or feathers taken from living birds, without injury to the same. The second section of the bill provides that there shall be no transportation of birds, feathers or parts of birds to be used or sold except as mentioned in the first section of the act from any State or Territory of the United States, to or through any State or Territory of the United States. The bill in many respects is a good one. The destruction of birds solely in order to procure their feathers for ornamental purposes has become so great that if it continues many years longer at the rate at which it is now going on, many of the species will soon become extinct. There are some weak features in the bill, as, for instance, the non-importation into the country of feathers, wings, etc., for ornamental purposes, even when they are obtained from game birds, which are killed each year by the million for food. When birds are killed for food, there is certainly no objection to utilizing the feathers, and there should be no reason why they cannot be legally sold.

TRAVEL TO PARIS.

The Paris Exposition is only a few months away and orders for transportation are pouring into the steamship companies in great volume. If the war in South Africa is not terminated within a very short time, it will seriously affect the passenger capacity of several of the principal lines, and the result will be that the facilities for trans-Atlantic travel will be totally inadequate to the demands which will be made upon it. The approximate monthly capacity of eight principal lines running to New York is 23,200. This amount would be larger if so many boats had not been taken away for use as transports. The Cunard line now has six of its steamers in the service, and the White Star line has three. One line has arranged with a large number of Paris hotels for special rates and will sell tickets at the New York office, including transportation to and from Paris, hotel expenses and admission to the grounds. The extra price will be about $30 per week, which includes an adequate number of admissions to the Exposition.

CIVIL ENGINEERS IN SESSION.

The Forty-seventh Annual Meeting of the American Society of Civil Engineers began January 17 at the building of the Society. After a business meeting the members listened to a lecture by Mr. William Barclay Parsons on the surveys he recently made in the Province of Hunan, China. In the evening a reception for the members and their families was held, and the next day the members of the Society took a trip around Manhattan Island, visiting the new power stations, the new viaduct over the Manhattan valley, the New York Central Railroad bridge and other points of interest. John Finley Wallace, of Chicago, was elected president; Rudolph Hering, vice-president.

A FOOT-POWER HAMMER.

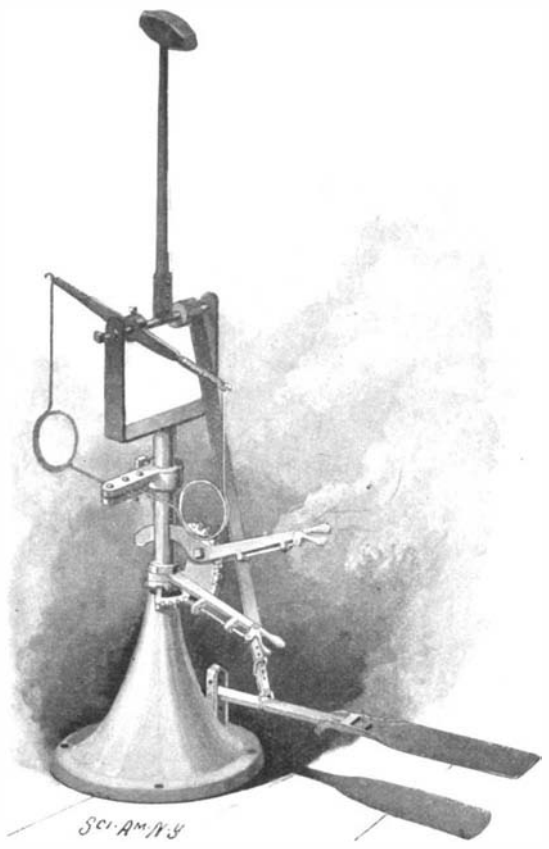
In an ingenious invention patented by Frank Dowling, of Coleridge, Neb., a mechanism is provided for holding a hammer or sledge, which is operated by the foot of the blacksmith whenever desired, thus dispensing with the services of an assistant.

Upon a strong, substantial base, a post, vertically and rotatably adjustable, is mounted. A sledge-hammer is pivotally mounted on the post; and to the pivot of the hammer oppositely-extending arms are secured provided at their ends with coil-springs hooked to the ends of upwardly-extending continuations of spirally-coiled springs, the horizontal continuations being clamped in a holder adjustably carried by the post. The tension of the springs will hold the hammer normally in vertical position.

In order to regulate the elevation of the sledge and the direction of its swing so that it can be made to strike on any portion of the anvil, a segmental horizontal rack is secured to the base, which rack is engaged by a lever mounted to turn horizontally on the base and provided with a vertical segmental rack. On this vertical rack a second lever is pivoted having an extension forward of its fulcrum, inserted through a slot in the post.

The pivot-shaft of the hammer is provided with a small pulley or roller to which one end of a belt is secured, the other end being buckled to the shank of a treadle, whereby the hammer is operated.

By means of this device the blacksmith can operate the sledge and simultaneously use a hand-hammer. The machine will cause the sledge always to strike in the same place.



DOWLING'S FOOT-POWER HAMMER.

CABLES OF THE NEW EAST RIVER BRIDGE.

The new East River Bridge will be the longest and considerably the largest suspension bridge in existence. Although it will be only a few feet longer between towers than the present New York and Brooklyn structure, the main span being 1,600 feet, the suspended structure will be considerably wider and more massive, the roadway having a full width of 118 feet and accommodating two steam railroad tracks, four trolley tracks, two roadways, and two passenger sidewalks.

The bridge has now reached the stage in its construction in which the contracts for the cables and suspenders have been let. We herewith present a sheet of drawings showing the details of these important elements of the structure. The cables will be four in number, and each cable will consist of 37 strands of No. 8 steel wire, each strand containing 281 wires. There will therefore be in each cable 10,397 wires, or 41,588 in the four cables. The wire will be 0·165 inch in diameter, and it must have a breaking strength of 200,000 pounds or more to the square inch, and it must show an elongation of at least 5 per cent in 8 inches of observed length. It must also be capable of being coiled cold around a rod of its own diameter without cracking. All the wires of each cable strand must be spliced so as to form one continuous wire. The splices (see drawings) must have 95 per cent of the full strength of the wire.

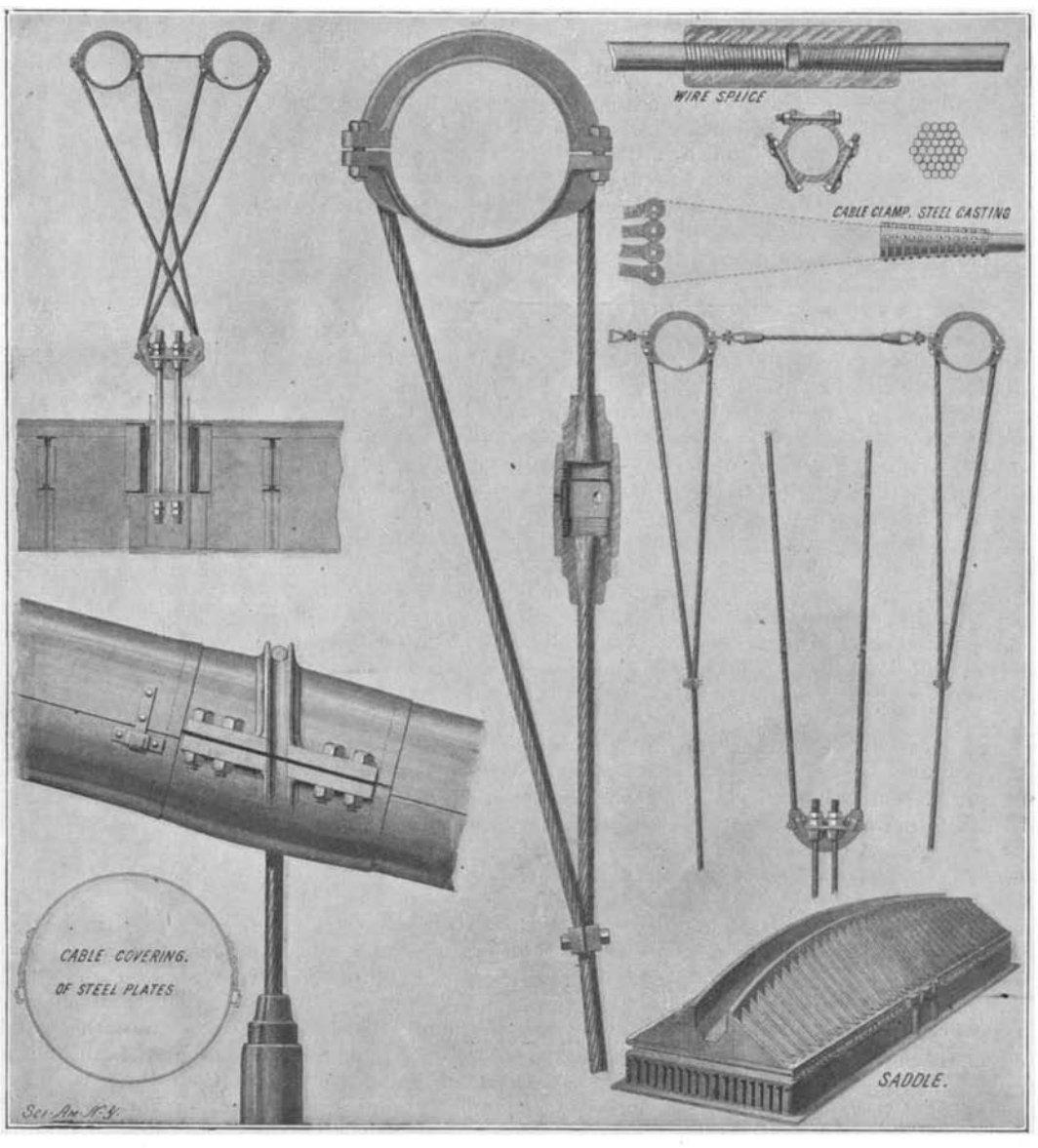
Great care will be taken to protect the wires from oxidation. As they come from the draw-plates in the mill they will be passed through hot linseed oil, and the assembled cables will be filled in and coated with a special cable filling. The 281 wires of each strand will be laid straight and banded with five or six turns of wire at intervals of five feet, to hold them temporarily in place, the interstices of the cable wires being filled with a special anti-oxidation filling. When the 37 strands that make up a cable are complete, the temporary wire wrappings will be removed; all the 10,397 wires will be drawn compactly into cylindrical form; and then at intervals of 20 feet the main cable bands (see drawings) will be put in place and screwed up so as to take a tight grip on the cable.

In the cables of the Brooklyn Bridge, protection is afforded from the weather by wrapping them with wire. This is not very satisfactory, as the changes of temperature cause the wires to separate, not, as was hoped, evenly, but at intervals of one or two feet. The openings thus formed are sufficient to allow the water to penetrate, and great care has to be exercised to prevent rusting of the cable wires. This is remedied in the East River Bridge by using half-round $\frac{1}{16}$-inch steel covering plates, which extend from main band to main band. The under half of the cover plate is put on first, and the cable filling, which is a mixture of pine tar and graphite and other ingredients and is absolutely undriable, is packed in between the cable and the shield, while more of it is plastered over the upper half of the cable. The upper half of the cover plates is then put on and locked to the lower half. Where the main band and cover plates meet, they are overlapped in such a way as to completely shed the rainwater and other moisture (see drawings). At the anchorage the strands of the cables will pass through a massive funnel-shaped cable-clamp (see drawings) and around 37 spools or "strand shoes," carried by the ends of the massive eye-bars which lead down to the base of the anchorages.

The suspenders, which will be placed abreast at every 20 feet of the length of the bridge, will be of 7-strand (wire core) steel wire rope 1¾ inches in diameter. On the Brooklyn Bridge there are four separate suspenders, one at each cable; but in the East River Bridge there will be but two, one to each pair of cables, as shown in the accompanying drawings. Each suspender will have socketed screw ends, one with a right and the other with a left hand thread, which will be joined by a sleeve nut as shown. Each of the main bands of the cable is cast with a half-round saddle to receive the suspender. The upper left hand figure of the drawings shows the method of attaching the floor system to the suspenders. This is done by means of four 2⅛-inch hanger bolts, which extend from the bottom flange of the stiffening truss, at the point of its intersection with the floor beam, to the bottom cast steel shoe or saddle of the suspenders. After the suspender has been laid over the upper main band saddle and beneath bottom shoe, and its ends coupled by the sleeve nut, the proper load is thrown upon the suspenders by means of a temporary knife-edge adjusting block. The nuts shown in our drawing are then screwed up and the adjusting block is removed. The smaller drawing shows a suspender at the center of the span, while the larger view shows a long suspender near the towers and the method of connecting up the lateral ties.

The saddles are massive ribbed castings of the form shown in the drawings, each of which weighs over 32½ tons. They are 7 feet 8 inches wide by 19 feet long and 4 feet deep at the center. The cable rests in a recess struck to a 21-foot 6½-inch radius, the recess being semi-octagonal in cross section. The saddles are supported upon twenty-two 15-inch steel channels, laid parallel with the axis of the bridge, and the movement of the saddles is provided for by the interposition of forty 2¼-inch steel rollers. In erecting the cables, the saddles will be placed 6½ inches back toward the anchorages from their final position. When the load of the suspenders and floor system is added, the saddles will be drawn forward 6½ inches to their normal position over the towers.

We are indebted for our information to Mr. L. L. Buck, the chief engineer, and Mr. O. F. Nichols, the chief assistant engineer of the bridge.



DETAILS OF CABLES AND SUSPENDERS FOR THE NEW EAST RIVER BRIDGE.

New Electric Light Carbons.

It is stated that a proposition will be made to this city to furnish it free of charge with a certain amount of a new kind of electric light carbons, so that tests may be made and the advantage of using them, if any there be, may be ascertained. The carbons are the invention of Frederick Hackman, of St. Paul, formerly of this city. It consists of a carbon tubing filled with calcium carbide powder. The effect, it is said, is the production of a light of at least eight times the brilliancy of the ordinary carbon. Mr. Hackman has tried to introduce this carbon in St. Paul, and the board of public works of that city has favored his idea to the extent that in advertising for bids for electric lighting it has specified his carbide carbon. The council also adopted the views of the board of public works in this respect. The proposition was that the company which furnishes the electric lighting for the city of St. Paul should furnish the current, meters should be supplied to determine the amount of current used, and that the company should be paid in proportion to this amount. The claim was made that the calcium carbide carbon light required a considerably smaller amount of current, as demonstrated by tests, and that a great saving would be made by the use of the new carbons. But the electric company, it is stated, claimed that by using the new carbon and having the current measured by meters it would be unable to run its plant at a profit, because the amount of current to be furnished by it would be smaller on account of the saving of the current.—Electrical World and Engineer.

Unique Church Edifice.

In a new church edifice which is being planned for erection in the city of Brooklyn, some unique ideas are being embodied. One of them is an open air auditorium on the roof, to be reached by elevators. It is thought that a large number of people will attend services if they could be held in the open air. It is a unique experiment, and this development of the roof garden idea will be watched with interest.

RECONSTRUCTION OF FARRAGUT'S FLAGSHIP, THE U. S. S. "HARTFORD."

By the kindness of Naval Constructor Frank W. Hibbs, of the Mare Island Navy Yard, we are enabled to present two illustrations of Admiral Farragut's famous old flagship, the "Hartford," one showing her in dry dock for resurvey, preparatory to her reconstruction, and the other representing the ship in her new rig and armed with a modern battery of rapid-fire guns.

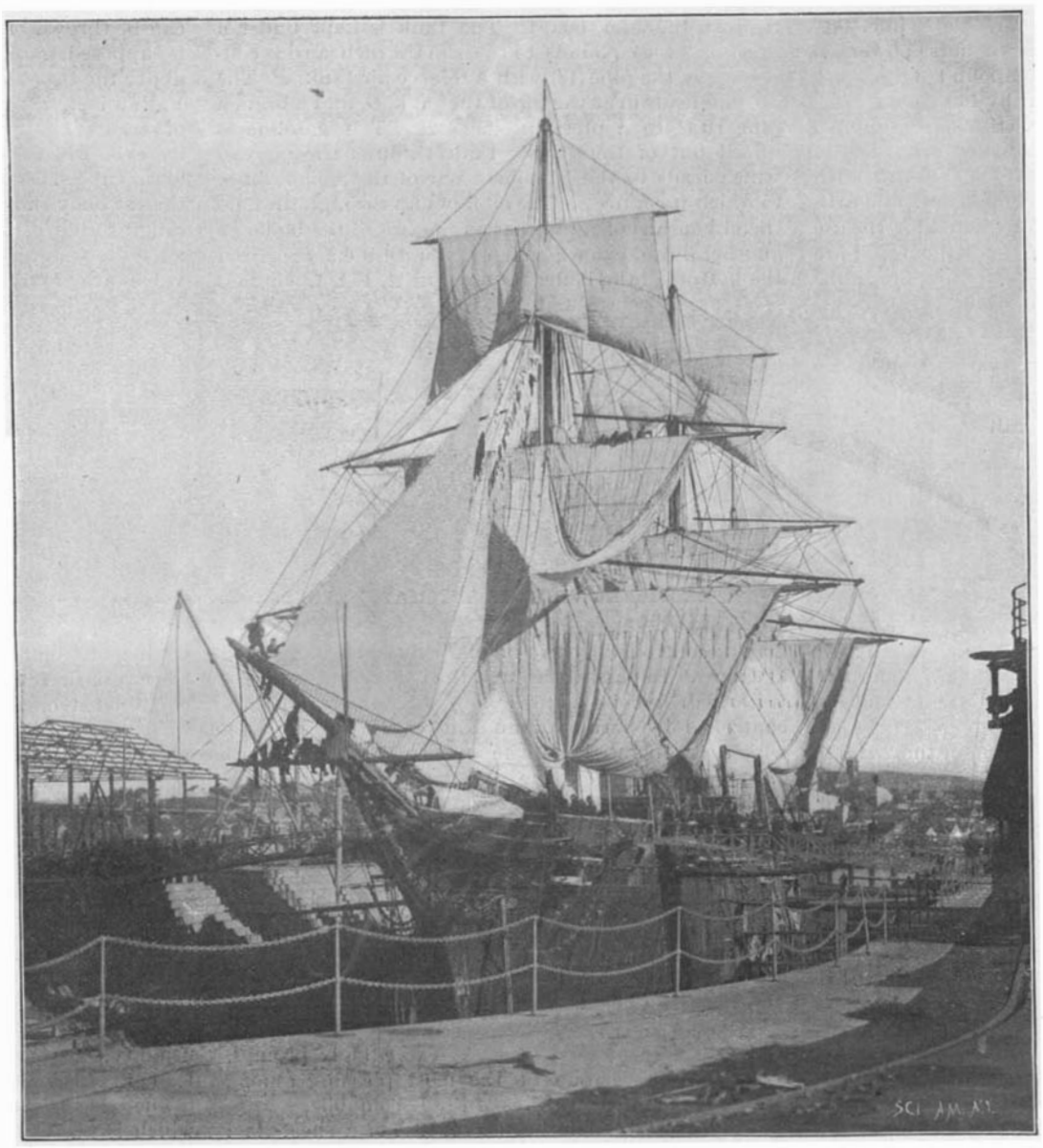
This famous vessel is endeared to the heart of the American people by her association with some of the most stirring scenes and with one of the greatest heroes of the Civil War. She acted as flagship of the fleet which, on August 5, 1864, forced its way through the seemingly impregnable entrance to Mobile Bay, and in so doing achieved one of the most daring and brilliantly successful feats in the history of naval operations.

At this time, when the "Hartford" has just entered upon a new lease of life and is again in commission, it will be in place to give some brief account of her part in the battle of Mobile Bay. The main entrance to the bay is about two miles in width and passes between Dauphin Island on the west and a tongue of land which extends from the eastern shore and terminates at Fort Morgan. The Confederates had narrowed down the available width of the entrance by driving a line of piles, and by laying a double line of torpedoes, until a channel only 300 feet wide was left over against the guns of Fort Morgan for the passage of the blockade-runners. The line of submarine mines consisted of 46 large casks and 134 smaller sheet iron cases loaded with powder. They were placed 7 feet below the surface of the water and were exploded on contact by means of a sensitive trigger. Fort Morgan commanded this channel with seven 10-inch and three 8-inch smooth-bore shell guns and eleven 32-pounders, while of rifled guns there were two 8-inch, two 7-inch, seven 6½-inch, three 5·8-inch. This formidable battery was arranged in three tiers. An exterior earthwork close by contained twenty-nine guns ranging from 32-pounders to 10-inch smooth-bores. Two miles away, on the other side of the channel, Fort Gaines was able to throw shot and shell from three 10-inch and twenty smaller smooth-bore guns. At the inner end of the channel was the Confederate "Tennessee," carrying two 110-pounder rifles, and four 95-pounders in broadside. She was assisted by three smaller Confederate gunboats. These four vessels were so stationed as to deliver a raking fire upon the Northern fleet at the same time that it was exposed to the terrific fire from Fort Morgan. Admiral Farragut forced the passage in line ahead, the monitors leading the way, followed by the unarmored ships of the "Hartford" type, which were lashed together in pairs, the larger and more powerful ship of the two being always placed to starboard, or on the side facing Fort Morgan. By way of protection the chain cables had been fastened along the starboard side of the wooden vessels. Nets were rigged to catch splinters, top hamper was sent down, and sand-bags were placed upon the deck as a protection against plunging shot. Farragut, in order to obtain an unobstructed view of the operations, chose his position in the rigging, and as the smoke mounted he climbed higher into the shrouds, until an officer, fearing that he might lose his balance in the shock of battle, was sent up to lash him in his place.

The "Hartford" suffered terribly in passing the fort and in her subsequent engagements with the "Tennessee." The foremast was struck twice at the first onset, and a shell exploding between the forward 9-inch guns laid out fifteen of the men who served them. The "Brooklyn," which was ahead of the "Hartford," betrayed some hesitation as she entered the channel, and on being ordered to go forward, signaled back the word "torpedoes." This brought forth Farragut's immortal "Damn the torpedoes; go ahead; four bells." At this time the "Tecumseh" was sunk by a torpedo, but the "Hartford," although the sheet iron torpedoes could be heard scraping along her bottom, passed safely over the mine field, and the Admiral was able shortly afterward to gather his fleet in the upper bay. In this engagement the "Hartford" lost twenty-five killed and twenty-eight wounded. Although her hull showed evidence of the terrific fire through which she passed, the chain cables saved it from fatal injury.

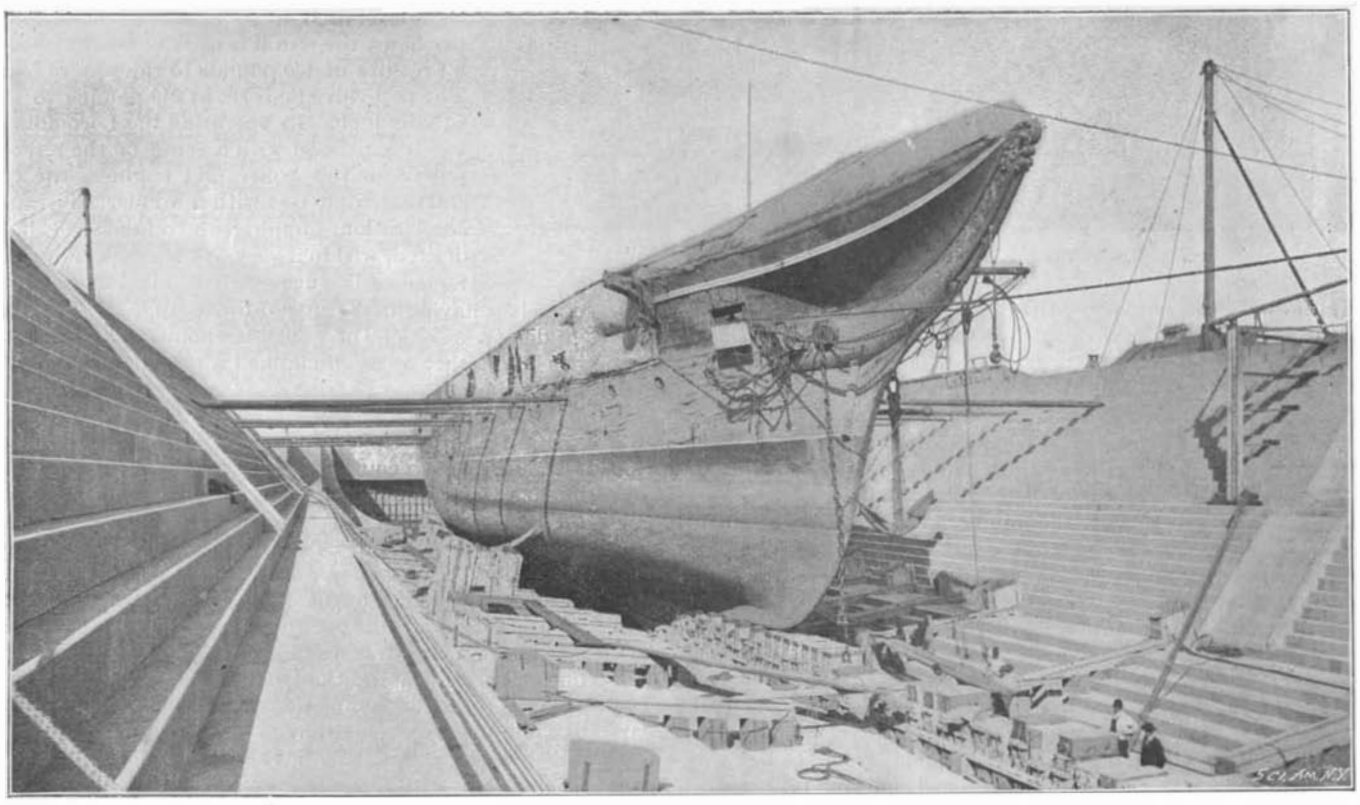
Thanks to the good people of Vallejo, which lies just across the straits from the Mare Island Navy Yard, the "Hartford," which had been laid up many years at that station, was granted a liberal appropriation by Congress for the purpose of thorough reconstruction, $276,000 being granted for restoring the hull, $150,000 for boilers and engines and $150,000 for armament. As originally built, the "Hartford" was a wooden steam frigate, 226 feet long over all, 44 feet beam, 18 feet 2 inches draught and 2,790 tons displacement.

The ship is still on her original lines, her present displacement being 2,799 tons on a normal draught of 18 feet 6 inches, while her length over all is 305 feet. She was originally ship-rigged, but as reconstructed she is bark-rigged, with stump-topgallantmasts. Her original battery at the time she was placed in commission in 1859 consisted of eighteen 9-inch smooth-bore Dahlgren guns in broadside; two 100-pound rifled Parrott guns on the forecastle; two 60-pound rifled Parrott guns

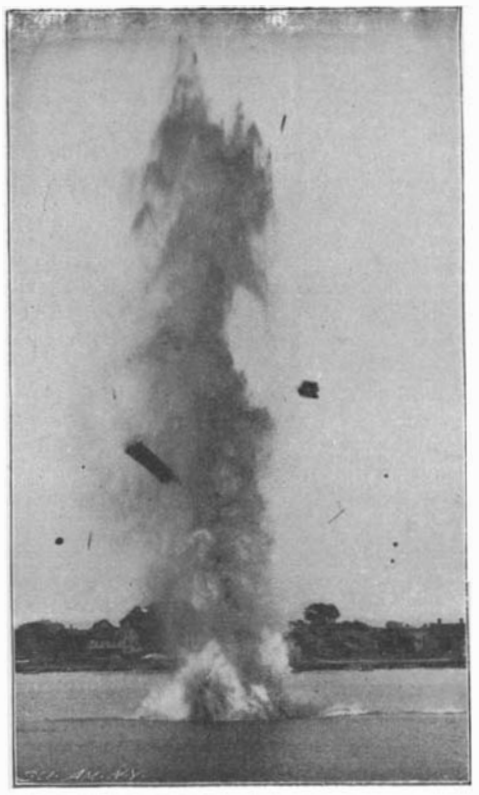


THE U. S. S. "HARTFORD" AS RECONSTRUCTED.

Displacement, 2,799 tons. **Speed,** 12 knots. **Coal Supply,** 258 tons. **Complement,** 244. **Armor:** none; ship constructed of wood. **Armament:** thirteen 5-inch rapid-fire guns; eight 6-pounders, two 1-pounders, automatic; two 1-pounders, Hotchkiss; two 3-inch field guns; two Colt automatic. **Date of Launch,** 1858; reconstructed, 1899.



HULL OF FARRAGUT'S FLAGSHIP "HARTFORD" IN DRY DOCK AT MARE ISLAND FOR RESURVEY.



EXPERIMENTAL BLOWING UP OF AN OLD MAINMAST OF THE "HARTFORD" AT NEWPORT TORPEDO-STATION.

on the poop deck, and three 12-pounder Colt howitzers in the tops. During the ship's reconstruction her top side planking and top timbers, her forecastle and poop deck, her stem, stern post, rudder post and rudder were all renewed. A new gun deck and upper deck were given her; her bulkheads, storerooms and magazines are all entirely new, and the fittings throughout the vessel have been renewed and are of modern type. The principal portion of the old ship remaining is that part of her which lies below her light water line.

The new engines of 2,000 indicated horse power are of the horizontal, back-acting, compound type, with cylinders 35 and 66 inches diameter by 48 inches stroke. She is propelled by a single screw. Steam is supplied by four boilers of the Scotch type, which are 11 feet in diameter by 10 feet in length. She is supplied with steam steering gear, electric lighting plant, and artificial ventilation, and her boilers are fitted for the use of forced draught. Her battery is of the rapid-fire type and consists of twelve 5-inch rapid-fire guns mounted in broadside on the gun deck, one 5-inch rapid-fire gun on the forecastle, eight 6-pounders mounted on the rail of the upper deck, two 1-pounder automatics on the poop deck, two 1-pounder Hotchkiss guns on the rail of the upper deck, two 3-inch field guns on carriages and two Colt automatic guns on the bridge. It will thus be seen that the famous old "Hartford" combines the picturesque features of the fighting ship of the sixties with the aggressive powers of the cruiser of the modern type. Although her spars have been cut down, she carries enough sail to give her crew, which will consist largely of recruits, something of that thorough training aloft which characterized the seaman of an earlier date.

In connection with the reconstruction of the "Hartford," the small photograph of the blowing up with guncotton of an old mainmast of the "Hartford" will be of interest. The mainmast was one removed from the ship before she left for the Pacific, and its destruction formed part of the experimental work of the torpedo station at Newport, Rhode Island.

THE "LOCOMOBILE" STEAM CARRIAGE.

In the early days of the present revival of automobilism, the steam engine was regarded with but little favor as a motor, chiefly because of the weight, bulk and general inconvenience accompanying the use of coal as fuel. With the introduction of liquid fuel, however, with its advantages of light weight and ease of storage and manipulation, the way was opened for the construction of a successful steam carriage, and the joint efforts of inventor and builder have produced some light, compact, powerful, easily managed, and eminently successful steam-driven automobiles.

We have selected for illustration, as combining most of the latest developments of the steam-driven type, the steam carriage which is popularly and commercially known as the "Locomobile." It has been sufficiently long on the road and has been tested under such varying and trying conditions as to prove that it is a thoroughly practical design, and representative of the unquestionable advantages and promising future of oil and steam in the field of automobilism.

THE CAR.—The car herewith illustrated carries two persons, and is of neat and decidedly prepossessing appearance. The body, which completely incloses the machinery, is suspended on a frame of 16-gage tubing by means of a transverse laminated plate spring at the front and two longitudinal springs of the same type at the rear. Above the two axles the frame is formed into two small bowstring trusses, to which the springs are securely bolted. Flexibility is secured by providing each of the two longitudinal members which connect these trusses with a slip joint connection (10 and 11), the end of the tube from 10 to 11 fitting snugly but loosely inside a sleeve at 10, and being held in place by an interior bolt which engages a lug brazed into the main longitudinal tube, and is adjusted by a nut at 11, as shown. This affords a strong but perfectly flexible construction, allowing the wheels to ride over obstructions without bringing any wrenching strains upon the frame or the machinery.

THE BOILER.—The shell, *A*, of the boiler consists of a length of 16-gage seamless, drawn, copper tubing, 14 inches in diameter by 14 inches deep. A half-inch flange is formed at top and bottom, to which the tube-sheets are riveted. A steam-tight joint is secured by brazing in the shell flange between the tube-plate and a steel ring on the under side of the flange, and riveting through as shown in the drawing. The boiler is then put in the lathe and two layers of piano wire, *a*, are wound on the shell under a moderate tension. Copper tubes, to the number of 298, are then expanded into the two tube-plates. This little boiler, as thus completed, has a total heating surface of no less than 42 square feet. It is hydraulically tested to 600 pounds pressure and when ready to be put in place it weighs just 105 pounds. It is covered with a thick layer of asbestos lagging, outside of which is an envelope of Russian iron.

THE FUEL.—The gasoline is carried in a copper tank, *O*, capable of holding three gallons, which is stowed beneath the foot board. The tank is kept under a pressure of 35 pounds to the square inch and is connected by the pipe (16) with a reserve air tank, *P*. The air pipe leads in at the top of the tank, *O*, and a branch pipe runs to a pressure gage, *R*. The gasoline is forced out of the supply tank through the pipe, *S*, which leads to the bottom of one of the boiler flues, to which it connects. The oil flows up through the flue, then by means of a pipe across the top of the boiler to another flue, down which it is led until it emerges from the bottom of the boiler to the pipe, *A*, Fig. 1, where it

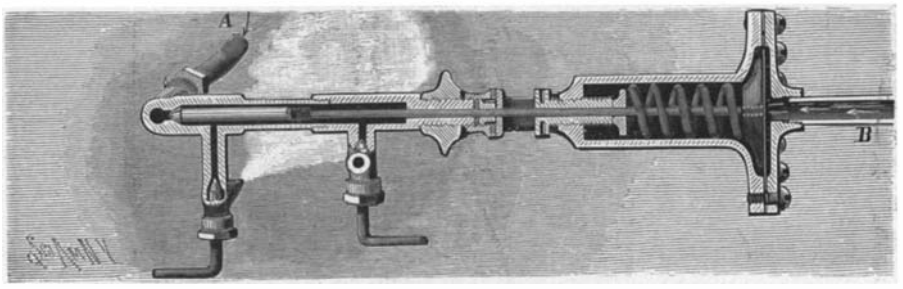


Fig. 1.—SECTIONAL VIEW OF AUTOMATIC REGULATOR.

may be controlled by two hand-operated needle valves, as shown. In passing through the boiler the gasoline is vaporized, and its admission to the burner at (7) is controlled by means of an automatic needle-valve, which is operated by the pressure of the water of the boiler upon the diaphragm, *V*. The diaphragm is so adjusted that when the boiler pressure exceeds 160 pounds, the valve will be closed, shutting off the supply of vapor. The steam pressure is thus automatically controlled through the burner, which, when the boiler has once been started, requires no further attention on the part of the operator. In order to prevent the fire from going out altogether when the vapor is shut off, a bypass of very small cross section is provided on the needle valve, which allows sufficient fuel to pass to keep the burner alight. The operation of the regulator valve is exceedingly prompt, and the device is one of the most pleasing among the many ingenious features of the Locomobile.

THE BURNER.—The burner consists of a sheet-steel cylinder of about the same diameter as the boiler, and is carried, as shown in our illustration, immediately below the latter; within the outer cylinder is a smaller inner one, into which the vaporized gasoline is fed. It is provided with 114 short vertical copper tubes, which extend from the bottom of the burner, where they are open to the air, to the top plate of the inner gasoline vapor cylinder. The air passes in through these tubes, and at the top it meets the gasoline vapor, which issues from the inner cylinder through a large number of small holes around the air tubes, the vapor and the air commingling and burning with the familiar Bunsen flame, immediately below the lower tube-sheet of the boiler. The distance from the base of the burner to the top of the boiler is about 19 inches, which allows it to be placed below the carriage seat and inclosed by the body, as shown.

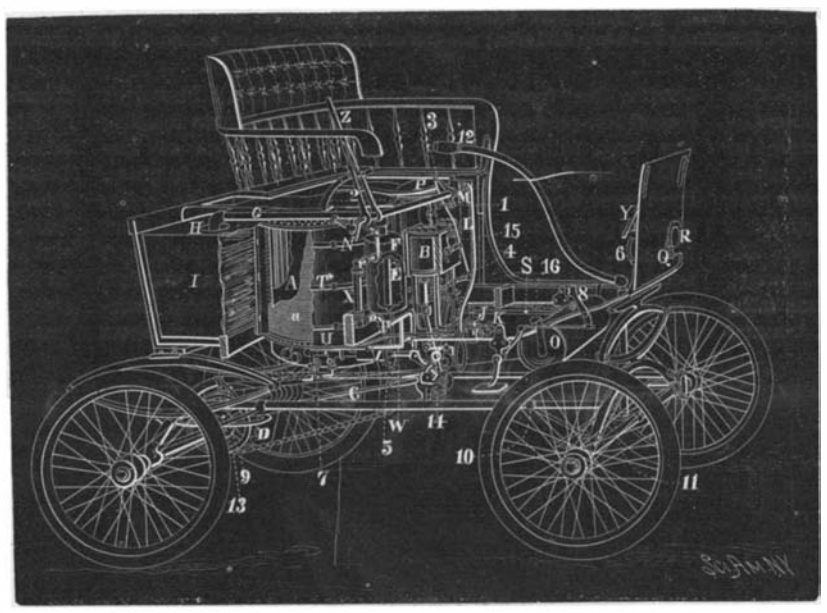


Fig. 2.—OUTLINE DIAGRAM OF THE "LOCOMOBILE."

THE BOILER FEED.—The water for the boiler is carried in a copper tank, *I*, which is placed at the rear of the boiler and partly encircles it. It has a capacity of 15 gallons. The boiler is fed by means of a little feed pump, *J*, which is operated from the cross-head of the engine. The water is led from the tank by means of a rubber pipe, and it may be cut off by a cock, *K*, before the check valve, which is just in front of the pump, is reached. There are three check valves in all between the water tank and boiler, and they all work in the same direction. From the feed-pump the water is forced directly to the boiler. A pipe, *L*, leads from the feed-pump to a by-pass, *M*, which is worked by the lever, *N*, placed conveniently at the hand of the driver. By turning this lever the feed, when the boiler is full, can be thrown back directly into the tank. The boiler is supposed, normally, to carry about 8 inches of water above the tube-sheet, leaving 5 inches of steam space; but an inch or two either way in the water level is not of serious consequence, the boiler steaming satisfactorily even when there is only an inch of water over the lower tube-sheet. A water-glass, *X*, on the outside of the car body shows at a glance the water level. By arranging a mirror, *Y*, on the dash board, the driver can have the water-glass continually under his eye. Check valves are provided above and below the water-glass, so that if the glass should break there would be no rush of steam or water from the boiler.

ENGINE AND DRIVING GEAR.—The engine, *B*, is located in front of the boiler and is secured to the frame of the body. It is shown so clearly in the accompanying engraving as to need no detailed description. It is sufficient to say it is a remarkably well designed and built two-cylinder engine of the locomotive type with Stevenson link motion and ordinary D-valves. The framing is of brass, and a special feature is the fact that the engine has ball-bearings both on the crank pins and the crank-shaft bearings. The engines are bolted to the wooden cross bracing of the body near the cylinders, and the lower part of the engine frame is kept in place by means of a strut, *C*, which extends from the engine frame back to the rear framing of the car. The strut is provided with a right and left hand turnbuckle, which enables the slack of the chain to be taken up when necessary. To allow for the slight movement due to this adjustment, the steam pipe is connected with the top of the steam-chest by means of a U-pipe provided with expansion joints. The driving of the rear axle is effected by means of a twelve-tooth sprocket on the engine shaft and a twenty-four tooth sprocket on the compensating gear-box on the rear axle. The compensating gear is of the usual type and allows of a perfectly independent rotation of the two wheels.

The band brake (9) is operated by a foot pedal (8), which is placed conveniently in front of the driver. The brake is extremely powerful and will bring the car to rest within its own length when it is running at a normal rate of speed. The car may also be brought to a speedy stop by reversing the engines. The reversing lever (2) and the starting lever, *Z*, are both located at the right hand of the driver, the former operating through the crank arms (3 and 4) directly upon the link motion, and the starting lever acting directly upon the throttle valve through the crank arm (1). The pair of cylinders are 2½ inches diameter by 4 inches stroke, with an ordinary cut-off at ⅝ of the stroke. They run at an average speed of 300 to 400 revolutions per minute and develop from 4 to 5 horse power. The cut-off of course can be varied as desired. On a level road, at a speed of 10 or 12 miles per hour, the steam is usually maintained at a pressure of 150 pounds to the square inch. The pop-valve (5) is set at 240 pounds to the square inch. In operating the Locomobile, one is impressed with a sense of the reserve power of the boiler and engines, the car starting from rest with a wonderfully rapid acceleration, jumping up to full speed, if so desired, within a very few lengths. They are remarkably successful as hill climbers, we ourselves having taken one of them up a 12½ per cent grade at a speed of 8 or 9 miles an hour. The same car has on another occasion climbed a grade of from 6 to 7 per cent.

OPERATION.—The boiler may be filled either by attaching a hose to the blow-off valve (14), which is furnished with a coupling for this purpose, or by filling the water tank, from which the boiler will of itself fill by gravity. When the tank is full, the blow-off needle valve is closed. The fire is started by means of a detachable vaporizer and burner, which is inserted into the permanent burner through the orifice (7). As soon as the steam pressure has been raised to 20 pounds or more, the needle valve at (7) to the main burner is opened, and the valve controlling the feed of gasoline to the detachable burner is closed. In about five minutes from the time the detachable burner is inserted, the steam will have risen to 150 pounds, at which point the automatic valve (*V*) will shut down the fire. The carriage is now ready to leave the stable, and beyond the steering, the driver has nothing

to occupy his attention in the operation of the Locomobile further than to keep his eye occasionally upon the water-glass. The exhaust steam enters the muffler (*F*) by a pipe (*E*) and leaves it by a pipe (*G*) which extends from near the bottom of the muffler past the boiler and down to a draught chimney (*H*) which passes through the center of the water tank. The gases from the boiler are drawn downward by the exhausted steam, and both together pass out through the bottom of the body of the car. When complete with water and fuel for a run of twenty-five miles, a Locomobile, such as the one we have illustrated, weighs about 550 pounds. It is carried upon bicycle wheels of the standard pattern, with 2½-inch single-tube tires of a specially heavy construction.

Automobile News.

A motor cab service is about to be introduced in Cologne, Germany.

The traction engines sent to South Africa for the use of the British army have arrived at Frere and have been successfully tested.

St. Vincent's Hospital, of New York city, has an electrical ambulance. It can travel at the rate of ten miles an hour and cost $2,000. It does not differ materially from the ordinary horse-drawn ambulance.

Had motor wagons been used instead of horses, it would have enabled the English gunners to get much nearer the enemy at the Tugela River, and it is probable that they would not have lost so much artillery. Of course the nature of the country must always have some bearing on the use of automobile vehicles.

An automobile hansom cab ran away in New York city January 18 and gave a valuable object lesson regarding the latent power of these vehicles. The accident occurred at Union Square, the cab was turning out to make way for a car; the pavement was slippery, and the cab slid over the Belgian blocks and the rear wheels struck the curb of the sidewalk. The driver's seat was evidently not well secured to the cab, for when the wheel struck the curb, the seat was thrown off the cab and the driver with it, in such a way that the cab ran over him injuring him internally. The cab without its master now began an erratic career. It went straight for the Washington equestrian statue in the southeastern corner of the square. The cab struck the fence around the statue like a snowplow, and the inch and a quarter iron pickets were snapped from the horizontal railing with ease. The railing was also broken and one of the tall hollow iron posts, nearly two feet in diameter, was twisted, broken, and canted over. The base, which was firmly set in the ground, stopped the progress of the cab. The wheels continued to revolve seemingly in impotent rage, the tire of one being partly ground off against the raw edge of the broken base of the pillar. It was some time before any one came along who understood the shutting off of the current. The cab was finally led away by a brother vehicle, and the driver was removed to the hospital. There have been two accidents of this kind in New York city within a short time. It seems as though they might be avoided by some automatic switch which would cut off the current instantly the driver leaves his seat. In case of accidents of any kind the power lever usually seems to be to blame, as it is almost the first thing which the driver seizes to keep himself from falling. A hand wheel would probably be much safer.

A Bullet-proof Shield.

Professor Biles, the well-known ship designer, has suggested that infantry should be provided with bullet-proof shields. Extensive experiments on this line have been made by Cammell & Company, of Sheffield, England. They have been carried out under Major F. Boynton. A shield has been devised which does not weigh more than 7 pounds and gives complete protection to the soldier against the service rifle at 400 yards range. It has been determined that this is the range beyond which protection is advisable, as it is well within that distance that military tactics provide for the bayonet charge. The thickness of the plate is 3-mm. and the area of the cover is about 150 square inches, which gives complete protection to a soldier lying prone upon the ground. A loophole is provided through which the barrel of the rifle projects, the arc of the fire commanded being about ninety degrees. There are three studs attached to the shields, these being provided so that the new shields can be locked into a continuous screen. The shields are built of steel which has special properties enabling it to be bent, punched or drilled, but which yet offers great obstruction to penetration by projectiles. The advantages of such a protection to troops are apparent. The shield is attached to the rifle by a special band and there are no spring catches, the object of the design being to avoid anything which will be liable to get out of order. It is hoped that by the use of this shield trenching operations will be largely avoided and the vexatious delays of pick and shovel work will be often rendered unnecessary.

Science Notes.

An International Congress of Ethnology will be held at Paris in connection with the Exposition from August 26 to September 1, 1900.

The President of the United States, through Secretary of State Hay, has sustained the decision of the United States Board on Geographical Names in regard to the spelling of our new island in the West Indies. It is to be spelled Puerto Rico.

There will be over 7,000 exhibitors at the Paris Exposition, and the United States is in the first rank of the exhibitors. The display will be strictly representative, and will show in an adequate manner the excellence of our productions. In 1873 we had less than a seventh as many exhibitors.

The explanation of a sudden rifle fire which was inexplicably opened from the Boer trenches is given by a newspaper correspondent. He says that the Boers had wires stretched along the ground in front of the trenches connected with lamps, so that if a wire was touched the lamp was extinguished. One night a lamp was put out by a high wind, and the result was that the Boers opened fire, although there was no enemy. The fire ceased when the Boers discovered that the alarm was false.

The expedition of Baron Toll, organized for the exploration of the New Siberia Islands and Sannikoff Land, will set out in June next from a Norwegian port, whence it will proceed to the mouth of the Lena, on the banks of which, at a point above the town of Yakutsk, it will pass the winter. During the summer of 1901 the expedition will begin its explorations toward the north, picking up en route a detachment which will be sent forward from the main body during March, with a sufficient supply of dogs.

The health of the U. S. Navy and Marine Corps is reported upon by the Surgeon-General of the Navy in his annual report, which shows that in the fiscal year 1898, notwithstanding war conditions and prolonged cruising in tropical waters, the ratio of admission to the sick list per 1,000 shows but a slight increase over past years. The ratio for 1898 was 871·69 per 1,000, as compared with 838 per 1,000 in 1895, 777·75 in 1896, and 748·24 in 1897. There were 173 deaths in the year, 118 being from disease and 55 from injury. Excluding the men lost on the "Maine," the death rate was only 7·21 per 1,000.

The annual meeting of the New York Botanical Garden has just been held, and the annual report shows that 165 new members have been added to the roll and that the progress at the garden under the direction of Dr. Britton has been most satisfactory. The number of species and varieties of plants under cultivation and those native to the grounds aggregate collectively over 4,000. The museum building is now essentially completed and needs only a final clearing out, when specimens can be installed. The number of new specimens received through gifts and purchase in the year aggregated 65,837.

A special commission has been appointed to report on the ruins of the cliff dwellers in the vicinity of Mancos and Cortes, Colo., and also near Aztec, Mexico, with the idea of reserving the lands as a national park. This action has been taken as a result of an agitation in Colorado for the protection of these ruins against vandalist relic hunters. Some of the best preserved ruins have been ruthlessly entered by curio hunters, who have broken through walls and roofs and carried away the relics. It would be very wise to have these ruins guarded by the government, and so that they can be investigated by experts. Fortunately, some of the best of them have not been tampered with as yet.

The Trustees of the Boston Museum of Fine Arts have purchased a fine tract of land of about 12 acres at the Huntington Avenue entrance to the Fens. This would give an opportunity for any desired enlargement of the collection. The Museum may be readily reached at this point, although it is not as near the center of the city as its present location at Copley Square, but owing to the fact that the light is deflected by the higher buildings in close proximity to it, the value of the present Museum building is impaired. In its new location the galleries would enjoy excellent light and immunity from fire communicated from other buildings. It may be some years before work is begun on the new site

The twelfth census of the United States in 1900 officially embraces all manner of statistics relating to all industries—except mining. Everything in connection with all trades has official, preliminary statistical notice—except mining; all classes and conditions of men are to be noted—except miners. The great basic industry of the nation, the one business that underlies all else, and on which all else depends, is not represented by any official notification of the intents or purposes of the twelfth census in the closing year of the century. The insane, the deaf, the dumb, are worthy of note, but there is no more mention of the mineral industry in the bill providing for the taking of the twelfth census than if such an industry did not exist.—Mining and Scientific Press.

Engineering Notes.

The French government is perfecting arrangements for the transportation by rail of torpedo boats of small size in the event of war.

The Simplon tunnel is now progressing at the rate of 16 feet per day. It was begun 14 months ago, and must be finished in five years and a half from its commencement.

A firm of rope manufacturers at Mulheim on Rhine manufacture steel wire towing ropes 5½ inches in circumference in one continuous length of nearly 19 miles and weighing 210 tons.

A pay car is to be used at the Homestead Steel Works. It will be run through the various departments, and the men will be paid off, obviating their calling at the pay office.

American ships built in 1899 numbered 954, and they had a gross tonnage of 267,642 tons. This is very close to 1898, when one ship more was built, and the tonnage was only 42 tons less.

There were 231 railroad accidents in the United States in the month of September, including 116 collisions and 110 derailments, causing the death of 93 persons and the injury of 226.

The Louisville & Nashville Railway has created the position of "horticultural agent." The duties of this official will be to encourage horticulture and truck raising along the line by means of information obtained in the same and other sections of the South.

The Hamburg-American line are about to introduce a new kind of fuel on their new freight steamers. It consists of a semi-fluid petroleum which is imported from Borneo in large quantities. It is not liable to become ignited spontaneously at high temperature. The new fuel will permit a reduction of the number of firemen and also a considerable economy of space.

The owner of a half interest in the patented design for "Island Station Platforms" has brought a suit in equity against the city of New York and the Rapid Transit Commissioners to enjoin them from using the patented design in the new underground railway system. The president of the Rapid Transit Commission says these platforms were in use on the London underground railway long before they were patented here.

It is estimated that Great Britain, the United States, and Germany have from two-thirds to three-fourths of the world's business in metals, shipping, finance, imports, exports, etc. These countries produce 77 per cent of the world's make of pig iron; 80·8 per cent of the steel; they take 75·2 per cent of the world's consumption of lead; 73·1 per cent of the copper; 67·5 per cent of the spelter; and 67·2 per cent of the tin.

The following figures, relating to the expansion and contraction of railway rails, 30 feet long, but of different weights, have been obtained by actual experiment in America: Contraction caused by change of temperature from 5 degrees above zero to 20 degrees below zero, 56 pound rail contracted $\frac{3}{16}$ inch, 75 pound rail $\frac{3}{16}$ inch, 85 pound rail $\frac{3}{20}$ inch; expansion caused by change of temperature from 5 degrees above zero to 70 degrees above zero, 56 pound rail $\frac{1}{12}$ inch, 75 pound rail $\frac{1}{16}$ inch, and 85 pound rail $\frac{1}{17}$ inch.

At the occasion of the centennial celebration at the Technical High School, Berlin-Charlottenburg, the Kaiser granted the Prussian technical high schools the right, in recognition of the scientific importance which they have attained in the last decades, besides the fulfillment of their practical labor, to promote their pupils, after passing an examination, to "diploma engineers," and after passing another examination to "doctor engineers." Hence, a "technical doctor" has been added to the number of various doctors in Prussia.

The dam separating the Chicago Drainage Canal and the Desplaines River was lowered on January 17, and the water of the former passed through on its way to the Mississippi and the Gulf of Mexico. The trustees became fearful that action by injunction to prevent them carrying out their plans might be taken by the enemies of the canal, and after a hurried consultation they decided to avoid the risk of further delay, so a permit was obtained from the Governor, and the trustees proceeded to Lockport, Ill., on a special train. The flow over the dam was between 250,000 and 300,000 cubic feet per minute, and when the gates are opened this flow will be increased.

A brick chimney, 160 feet high and 8½ feet square at the base, and 4½ feet diameter at the top, has been overthrown in St. Louis by the use of hydraulic jacks, says The Engineer. The chimney was first undermined on one side, and three 10-ton hydraulic jacks were placed in position under the side. A hawser was then fastened about the chimney, 60 feet from the ground, and ropes led from this hawser to crabs placed at a distance of about 100 feet from the chimney. With eight men at each crab and men at the hydraulic jacks, the chimney was slightly lifted and pulled at the same time; the men at the jacks left their posts at the first warning crack, but those at the crabs continued their work until the chimney fell.

THE NATIVES OF SOUTH AFRICA.

BY EDGAR MELS, FORMERLY EDITOR OF THE JOHANNESBURG DAILY NEWS.

Statisticians assert that there are eleven hundred and fifty-one distinctive tribes of natives in South Africa, south of the Zambesi River. Most persons who have lived in that part of the world will cheerfully assert that this census is far below the truth—if dialects and racial differences count for aught. Rough guesses place the number of natives at from two to ten millions, but, as a matter of fact, no one knows even approximately their number. This lack of information is due to the roving propensities of the natives. Here

A BASUTO WOMAN DRESSED FOR A RELIGIOUS CEREMONIAL.

to-day, there to-morrow, it would take a mightier hunter than even the famed Selous to hunt them all down.

The writer has seen the South African native, commonly called Kafir, in all his varying phases, in his wild state, semi-civilized and wholly so. He has seen the native at his best and at his worst—untainted by the touch of civilization and soiled by its proximity. And through it all, the writer has believed, and perhaps always will, that the Kafir, whether Zulu or Basuto or Bechuana or Swazie or Amatonga or Matabele or any other tribe, has good in him, just as though his skin were white—and bad too.

Summed up in a few words, the Kafir, in his uncivilized state, is an overgrown child, with childish foibles and shortcomings. But let him learn the vices of civilization, let him realize the evil there is in him, let him discover that there is a broad path leading to destruction—and you will find a fully civilized being, as capable in certain directions as is the white man.

It is a fact that where the Kafir is permitted to dwell in primeval ignorance, with none to warn him against vices he knows nothing about, he remains a good Christian, even though he is ignorant of doctrinal disputes and the meaning of higher criticism. It is equally a fact that where he imbibes a little learning, especially a knowledge of English, he becomes all that is worst in a human being.

A study of the Kafir is a study of the human being. And what is more, he has been grossly and shamefully maltreated. Space prevents a recital of the wrongs of the native, so to a dissertation as to his idiosyncrasies and peculiarities.

It must be borne in mind that the Kafir is very much unlike the American negro. There is no blood taint in the Zulu nor consumption in the Matabele. Endowed with a superabundance of animal health and a constitution untainted (in most cases) by civilization, the average Kafir is a magnificent specimen of humanity. And here the difference between him and his American ex-brethren asserts itself. Put a Southern "darky," and a Zulu side by side, and the difference will be apparent to the most casual observer. The skin of the Zulu is totally unlike that of a negro as we know him. The Zulu's cuticle is transparent—so much so, that the red blood can be seen coursing beneath it. That is the Zulu's greatest pride. He will point to his skin to prove that he is a pure-bred Zulu—the real Ethiopian of the ancients. And it is so with the other tribes. The flat feet and bowed legs and other peculiarities of the American negro are all missing.

As for the morality of the Kafir—that differs according to the tribe and its proximity to civilization. The Zulu is eminently virtuous. Infraction of the law of morality is punished by death. The culprits are placed on the ground with their respective heads resting upon a flat stone. Then their heads are crushed with another stone. On the other hand, the Hottentot, having been a close companion of the white man, is the most immoral and depraved human being perhaps in existence. The Matabeles are moral, so are the Basutos and the Mashonas. The Bechuanas are less so, and the Buhsmen rank next to the despised Hottentots. That the latter are as bad as stated is evident when the Zulus will not work in the same mine with one nor sleep in the same room or kraal.

Nearly all the tribes, save the Hottentots and Bushmen, are cleanly, the Zulus particularly so. The Zulu goes in bathing twice a day. He cleanses his teeth with milk at sunrise and again at sunset.

All the tribes, even those partially civilized, believe in ghosts and spirits. Many worship the spirits of the departed. Still others are fetish worshipers.

The most advanced tribe is the Basuto nation, in which there are fifty thousand Christians, with one hundred and forty-four schools. Strict as are the laws against the indiscriminate selling of liquors to natives, they are yet able to obtain all they want. And when their supply of ordinary rum and whisky runs short, they manufacture the notorious "Cape Smoke." This addiction to alcohol is the great curse of the Basutos, and, in fact, of every other tribe.

Cape Smoke must be tasted to be appreciated—provided the person thus experimenting survives. For be it known that Cape Smoke consists of wood alcohol, red pepper and sulphuric acid. This terrible concoction is relished by the Kafirs as no European drink is—they have not yet been civilized up to the level of the American "mixed drink."

But to return to the Basutos. For more than one hundred years this tribe has been undergoing a process of forcible civilization. Good men and good women have sacrificed their lives to the noble cause.

Just before the present war began, there was a gathering of Indunas, or native priests, near the Free State border. Thousands of "Christian" natives attended. Two oxen were brought into a ring formed for the purpose. One of the animals was snow white, representing the British. The other, coal black, represented the Boers. With weird incantations and wild dances, these Christianized Basutos skinned the poor oxen alive. The white ox succumbed after five hours of terrible agony; the black one lived for nearly a day and a night. The gods of the "Christian" Basutos had answered the oracle—the Boers would win.

The Kafir is a stoic. With him, what is, is. I have seen a Zulu's toe crushed by a rock. Calmly he cut the injured member off, tied the wound up with a rag, and then as calmly resumed work. This stoicism it is that makes the Kafir such a formidable foe.

The native does not know his own power—due to numerical superiority. Arm him with modern weapons and you build a Frankenstein, who will prove as terrible a conundrum as Mrs. Shelley's monster. For despite his schooling and christianizing and civilizing, the Kafir remains a Kafir, unable to forget his wrongs, and

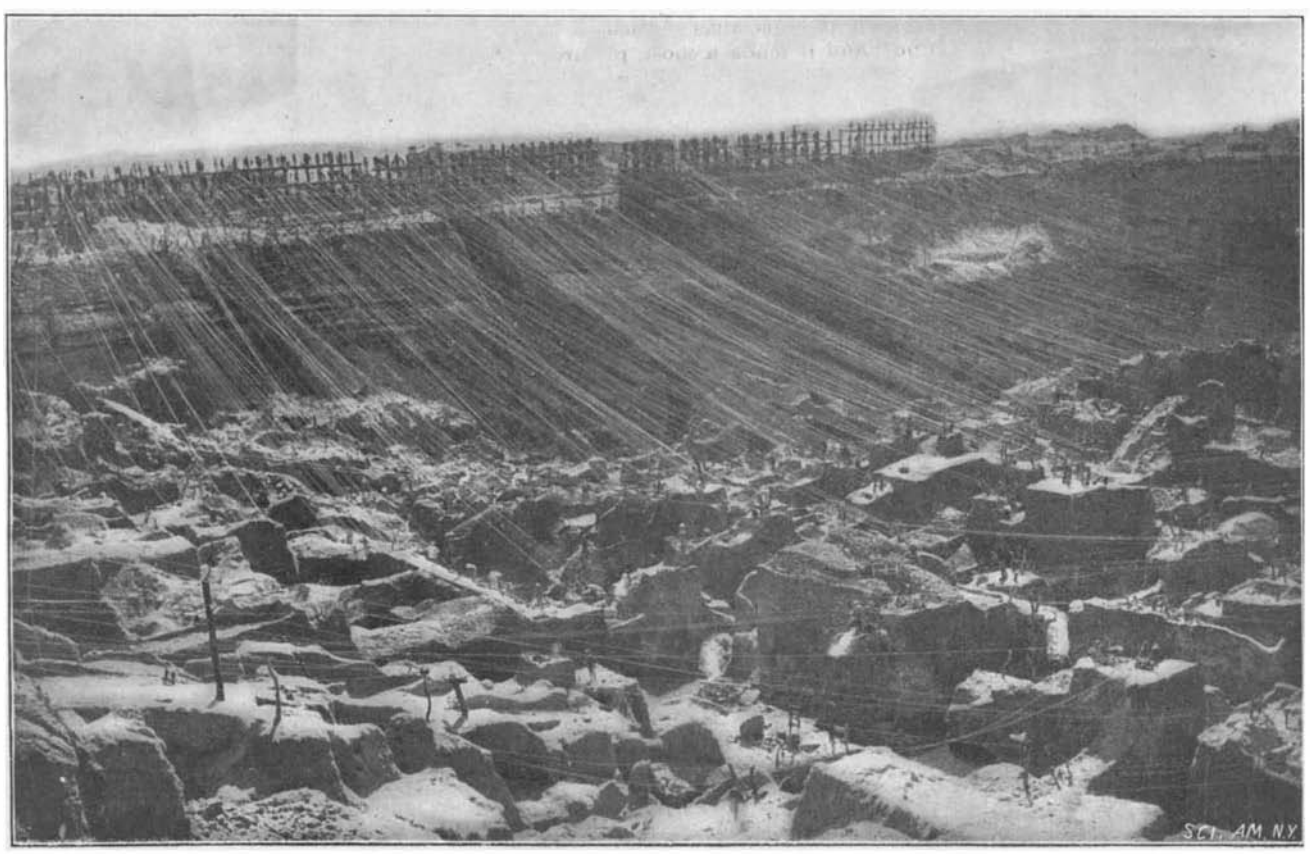
KAFIRS WITH SUGAR-CANE.

held in leash only through fear of the white man's death-dealing weapons. Even now the Basutos are considering the advisability of attacking the side that will lose in the campaign between the contending white men. Let the British be defeated a few more times, and even the loyalty of the Basuto chief, Lerothodi, will not be able to stem the tide. The only preventive of open hostility, even at this writing, is the parliamentary form of government of the Basutos.

Basutoland, while nominally independent, is yet a British colony. It is governed by a High Commissioner, who in turn is ruled by the governor of Cape Colony. The native chiefs adjudicate all disputes between natives, although an appeal can be taken to the Magistrate's Court, where cases between whites are tried. The revenues are derived from the Cape Colony contribution, the post office, native hut tax and the sale of licenses. Whites are not wanted in Basutoland and everything possible is done to keep them out. The land belongs to the natives, and the unutilized soil is allotted to householders for grazing purposes. The chief allots fields to each householder, who cannot sell the land, but whose descendants get it on his death. Several times a year the chiefs of the nation hold a national assembly called the Pitso. Here any native can freely express his opinion without fear. He can take refuge behind his status as a member of the Basuto parliament.

In this respect the Basutos are far in advance of the other tribes, most of which are ruled in despotic manner, by chiefs more renowned for their appetites for blood than for aught else.

As for the dress of the natives, in civilized districts, that is regulated by local statutes. Nowadays, all are forced to wear more or less civilized clothing. Fashion does not, however, dictate as to what they shall wear, and so ludicrous results ensue. It is not uncommon to see a native dressed in a breech cloth, a red



THE GREAT DIAMOND MINE OF KIMBERLEY, LOOKING TOWARD THE "REEF" AND STAGING.

Eton army jacket and a silk hat. Others prefer white duck trousers and a woman's bonnet. As for the women, they are content with whatever their lords and masters may allot to them.

The accompanying reproductions of photographs represent the best type of the Kafirs. One peculiarity that will interest bachelors is that, as shown in the pictures, the married men have a band drawn around their hair, while those still in single misery are without this emblem.

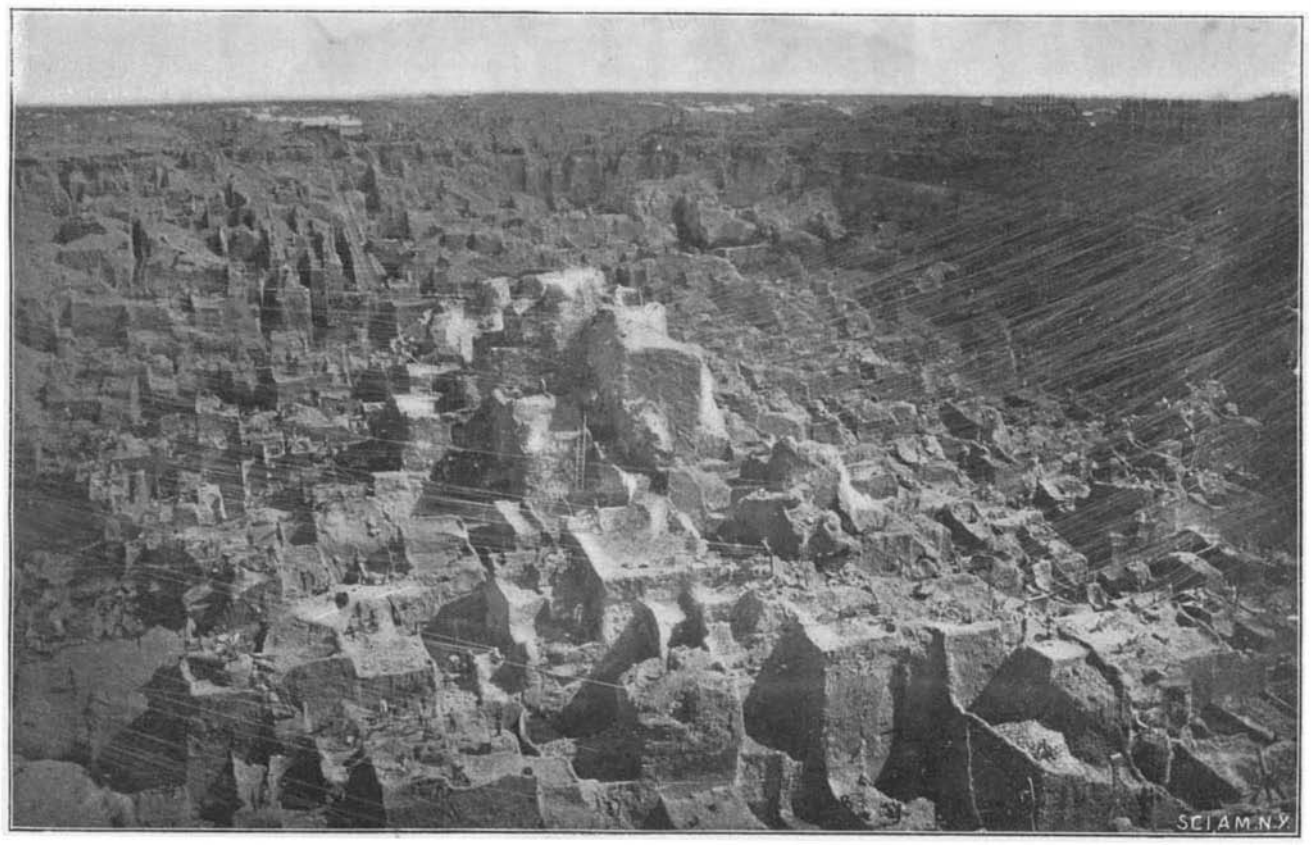
One word more; the black question in South Africa will yet prove a far more serious question than the black question in the South. And the white man must shoulder the blame, it is his burden.

THE DIAMOND MINES OF KIMBERLEY.

The attack on Kimberley by the Boer forces has caused considerable public interest in the great diamond mines which now produce about ninety-five per cent of the annual output of the world. The story of these mines is a most fascinating one, and is even more interesting than our own California gold fever of '49.

In 1750, a missionary marked a map of Africa at the point where Kimberley now is with the words "Here be diamonds;" but it was not until the year 1867 that this source of wealth was discovered, and the great elevated desert of Colesberg Kopje, just outside the western border of the Orange Free State, began to teem with life. The wilderness had been given over to the Griquas, a tribe or nation of mixed Dutch and Kafir origin. In 1867, John O'Reilly obtained of a Dutch farmer, named Van Niekirk, a stone which the latter had bought of a little Griqua boy. O'Reilly sold the stone and divided the $2,500 with Van Niekirk, who bought another one from a little Hottentot boy, and it was sold in Cape Town for $50,000. This was the famous "Star of South Africa," weighing 83½ carats. Prospectors began to flock to the region, and in 1869 Kimberley was formally founded. The territory was ceded to the British authorities and became "Griqualand West," a territory of Cape Colony, comprising 15,197 square miles, and a total population of 83,375. Kimberley itself had, in 1891, a population of 28,718. The rush to the diamond fields was usually made by means of ox-trains, and the prospectors suffered many privations, which were more than compensated for by the rich harvest. The pioneer miners simply dug and sifted, each man for himself, or for self and partner. The methods employed were the crudest imaginable, rough cradles being used. The results were phenomenal, and some men became rich in an hour. The first diamonds were discovered along the Vaal River, some 20 miles from Kimberley, but in 1871 diamonds were discovered at Dutoit's Pan, a short distance from that place. The crowds rushed to the new fields, or the "dry diggings" as they were called. The discovery of the stones was soon made at "New Rush," or Kimberley, which shortly became the supreme center of the mining industry.

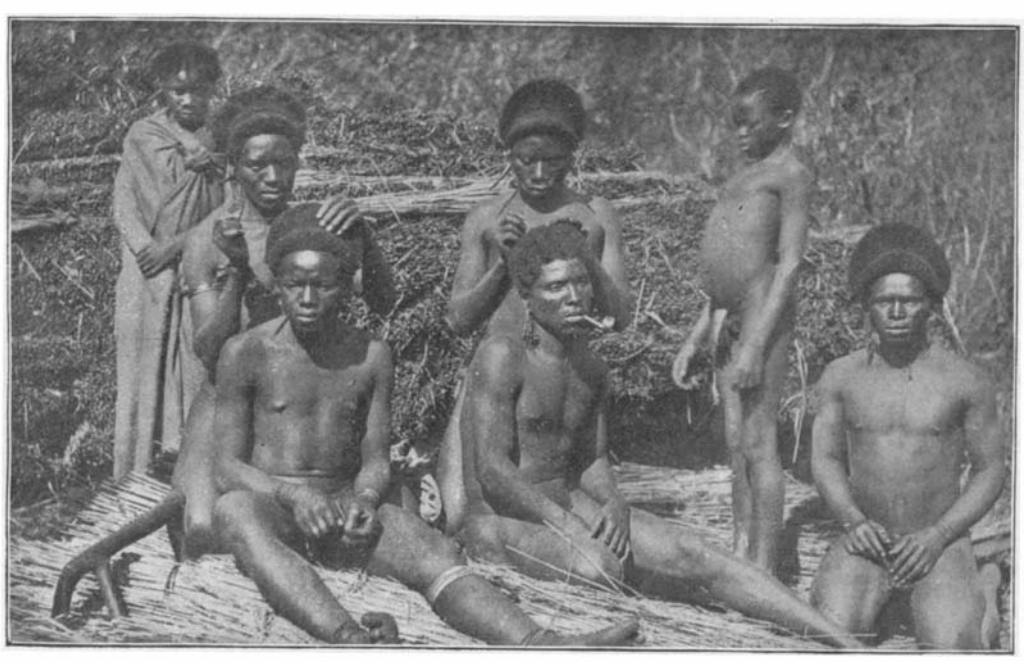
The original Kimberley mine had an area of 13 acres, and this was soon converted into an enormous hole, which has been extended until now it is about 1,100 feet deep. The diamonds come in what are known as "pipes," which run down through the layers of shale, which are stratified. Twenty years ago the mine presented a most remarkable appearance, and we have been fortunate enough to secure photographs taken about this time, which was before the days of consolidation, and the mine was all divided up into small claims. The edge of the rock which surrounded the mine was termed the "reef," and from it could be obtained an excellent view of the mine itself, which seemed at first to be a collection of houses of cliff dwellers. It was perhaps 1,000 feet across, and the whole surface was covered by hundreds of wire ropes which ran up to staging at the top, which consisted of a framework carrying three sets of sheaves superimposed. It should be said that each of the newcomers to the mine staked out a claim 31 feet square. It was staked out by a surveyor, and when this was done the owners could dig out all that section of the earth as far as they could go. There was a small tax of $2.50 a month on each claim. Some of these claims proved to be much better than others, and some were worked much more rapidly than others, the result being that no two adjacent claims seemed to be of the same altitude, and it made a most picturesque appearance; but the accidents from falling earth were of great frequency and were very serious. Each claim was connected with the staging by a wire rope which ran over wheels about four feet in diameter, the wheels being turned with the aid of cranks by four careful workmen. The ropes ran at all angles, some of them being almost vertical, where they served the claims almost under the staging. Each wire rope was secured to a post which was driven in the claim. The bucket ran on the wire rope. At first the buckets were made of ox hide, and when it was filled with the blue earth which contained the diamonds, it was hauled up by the stalwart Kafirs, so that each claim was to all intents and purposes a separate mine. The soil proved to be remarkably valuable, and the great open shaft was sunk rapidly. The claims were very largely subdivided, and even a small section of one proved to be of great value.



THE DIAMOND MINE AT KIMBERLEY, SHOWING INDIVIDUAL CLAIMS, TWENTY YEARS AGO.

The miners were greatly hindered in their work by water which invaded the diamond field. The reef had to be constantly pared to prevent it from sliding into the mine proper. Some of the diamonds were, of course, picked out during the digging, but a large part of the work was done at the surface. At first the dry process was employed, but finally washing machines were introduced which enabled them to work abandoned piles and tailings. The Kafirs were, of course, constantly watched to prevent them secreting any diamonds, and they were kept in what was termed a "compound" for three, six, nine or twelve months, depending upon the agreement which they made. During this time they were virtually prisoners. They were not allowed to leave the stockade.

In time, methods began to change in the mines, and small capitalists were crowded from the field. The expense of raising the earth constantly increased, the depth necessitating the use of horse whims instead of the old method of using Kafir labor. The reef was constantly crumbling, and the expense of working caused by the influx of water forced many owners of claims to sell out to larger miners. The result was that in time the methods of diamond mining became entirely changed; and while the operation was more rapid and thorough and was less expensive, it could be



MAKING A ZULU TOILET.

GROUP OF UNMARRIED ZULUS.

conducted only on a very large scale. The mines today are nothing like as picturesque as they were when the photographs we show were taken, as it was found that open mining, that is, cutting ground away in great bits like stone quarries, was impracticable on a large scale, so that at the present time deep covered shafts and galleries have been substituted. With all the resources of modern diamond-mining machinery, the final work of picking out diamonds from a mass of pebbles calls for skill, responsible, and, of course, proportionately highly paid labor. Ever since the mines were first opened, great attention was paid to the native diamond thief and to the white man whose business it was to buy stolen diamonds from the native workmen. The latter were known as the "I.D.B.s," illicit diamond buyers. To prevent the natives from yielding to their blandishments, the latter are kept in the compounds, or stockades, and even high wire nettings crown the fence to prevent them from throwing over packages containing diamonds. The laws are so strict that if a person should find a diamond on the street, he would at once have to take it to the police to be registered before he could legally have any claim to its possession. When the individual claims were being worked, some miners would dig into their neighbors' claims in such a way that the blue ground which was so much desired would tumble into their own workings. This was one of the evils which was naturally incidental to the existence of 3,143 separate claims within an area of 1½ square miles. Now matters are entirely changed. Great companies, like the De Beers, have consolidated, with a capital of $18,500,000. Of course, the possession of the mines by one or two corporations has given them an enormous power over the diamond market, and now it is said that there are many millions of dollars' worth of diamonds lying in the vaults at Kimberley, which are not intended to be put on the market until the conditions are ripe to obtain the highest possible price. It is needless to say that the mines pay handsome dividends, and there have been many enormous fortunes made in them.

The Trans-Siberian Railway.

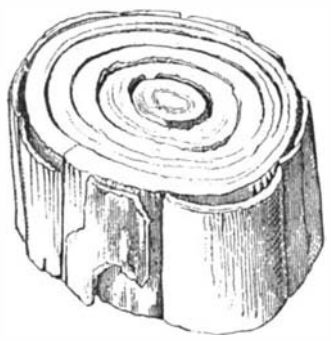
A Russian newspaper has recently published some interesting particulars regarding the Trans-Siberian Railroad, which our commercial agent at Vladivostock, Mr. R. T. Greener, has supplemented by some facts of his own. In the haste of construction and the anxiety to get everything cheap, a special kind of light rails weighing 12 pounds to the foot was used on both the Siberian and Trans-Baikal lines. Wooden bridges were built wherever possible, and the crossings were made far apart. Under such conditions quick traveling on the road will be almost an impossibility, and it is doubtful if more than 20 miles an hour can be made. Only one passenger and two freight trains a day are run. To add to the danger, they put on the line a very heavy engine. The light weight of the rails and the steep gradients combine to make traveling very risky. On steep inclines the train drawn by the powerful locomotive already referred to runs 33 miles an hour, which has seriously injured the rails, and eleven cars were destroyed at one station. The engineers have come to the conclusion that a great deal of the road must be reconstructed. On the Trans-Baikal line there will have to be spent no less than $7,725,000, almost 50 per cent of the entire cost of the line; on the whole Siberian railroad, there will have to be spent not less than $62,750,000. The light-weight rails must be thrown aside, the wooden bridges replaced, and the number of stations increased. In places the engineers laid out the line on marshy ground instead of on the highlands where the ground is solid and firm, and in the near future it will have to be relaid. In some districts the mistake was committed in the choice of the direction of the line. Tomsk, the capital of western Siberia, was left 53 miles on the side and connected with the railroad by a bad road. In order to foster home trade, the rails and other supplies were ordered principally from Russian iron works in the Ural district, and they cost twice as much as if they had been obtained abroad. A considerable quantity of material was prepared in advance, and it became rotted before it could be used. The general cost of the great Siberian railroad is estimated at $180,250,000, including $60,770,000 for the construction of the Amur line, which project has been changed by the building of the Manchurian line. The last will cost $51,500,000.

It will be constructed by a joint stock company, but most of the shares are in the government's hands. The cost of a mile of railroad varies from $18,025 to $25,750 a mile, depending on the location. When the Manchurian line is completed, the distance from St. Petersburg to Port Arthur will be 5,819 miles, from Berlin 6,331 miles, and from Paris 7,060 miles.

As soon as the road is finished, it will be the shortest route between Europe and the Far East. One will be able to go from Paris to Yokohama in seventeen days. At present it requires twenty-five days going by way of Canada. The fare from London or Paris to the ports of the Far East is about $367 first-class; while in Russia, thanks to the lowered passenger tariff on great distances, one will be able to travel from the German frontier to Port Arthur or Vladivostock for $57 first-class, or a special train for $86. The cost of traveling from the west to the furthest point in the east will not be more than $175. Owing to the enormous distances, everything is being done to make the trip comfortable. Special Siberian trains will leave Paris weekly. There will be library, dining, bath and gymnasium cars, and traveling with such comforts would not be much more tedious and disagreeable than a long voyage by sea, except that a lack of exercise would undoubtedly be felt. The cost of transporting freight will hardly show as much decrease. In 1897, the cost of transporting freight from Shanghai to London, by water, was $9 per ton, and in February, 1898, it had dropped to $5.60. The Siberian road will not be able to compete at all with these prices; and while the freight-carrying trade between China and Western Europe will probably not amount to a great deal, the trade which the railroad will develop between China and Russia will be very considerable. The Siberian line will be of great importance as a means of quick and cheap passenger and mail communication between the different points in the two continents, which is alone sufficient to make it play a great rôle in international affairs.

CURIOUS MISHAP TO A BILLIARD BALL.

The mutilated billiard ball shown in the illustration was brought to this office by a friend who thought the subject would be of public interest. At first sight one would naturally suppose that the perforated ball and snugly fitting plug were the work of some deft mechanic, for despite its taper and irregular section, the one fits the other so closely that it is difficult to detect



SECTION OF DISINTEGRATED MAMMOTH TUSK, SHOWING NATURAL LINE OF SEPARATION.

CURIOUS MISHAP TO A BILLIARD BALL.

the joint. As a matter of fact, however, the "trick" was done, involuntarily, during a game of billiards, when this particular ball was struck heavily by another ball on the figure 13, with the result that the heart of the ivory was driven cleanly out, as shown in the illustration.

If a cross-section be taken of an ivory tusk, the center will contain a spot (the remains of the pulp) of darker color than the rest, and concentric with this will be noticed numerous circular contour lines, which are due to minute curved spaces, known as "interglobular spaces." In these spaces there is less of lime salts and more of organic matter than in the rest of the ivory. Hence, the ivory in these rings is less dense, and more likely to decay, and fossil tusks and the tusks of mammoths are frequently found to have separated into a central solid cone, with several superposed hollow cones embracing it, as shown in our engraving.

This billiard ball had evidently been turned from the heart of the ivory, the axis of the tusk coinciding closely with the axis of the ball. The sharp blow must have been delivered fairly in a line with the axis of the heart, and the piece which was driven out gave way at the circular line of cleavage, marking the presence of the "interglobular spaces" above referred to.

The Pollok Memorial Prize.

In response to the request of many of our readers, we publish in the current issue of the Supplement the official regulations regarding the competition for the Anthony Pollok $20,000 prize for life-saving devices, and those of our readers who are considering the advisability of exhibiting devices of this kind are referred to this issue for full official information. Detailed plans and specifications should be sent to John H. McGibbons, Director of Exploitation of the Paris Exposition Commission, Equitable Building, 120 Broadway, New York, and the exhibits should be marked "Pollok Memorial Prize." Small models may also be sent there.

As Others See Us.

At the close of the year, when many subscriptions to the Scientific American expire, the publishers often receive, together with the renewals, letters commenting upon the work of the editor during the past year. The publishers believe that it is only fair that readers should know something of the encouragement received, entirely unsolicited, by the editor concerning his work. It is, therefore, with all due modesty, but with a feeling of justifiable pride, that the following extracts from letters recently received should be quoted:

An admiral in the United States navy says:

"The Scientific American is second to none in this country, either in the scientific ability of its staff, or in its patriotic utterances."

A clergyman writes:

"I find that the Scientific American is helpful in my ministerial work. It keeps me in touch with the scientific world, thus having before me an object lesson of the wonderful works of God.'"

A physician writes:

"I have been a constant reader for over thirty years and think the Scientific American is as useful to the practising physician as a medical journal."

Some members of Congress write:

"It is a great paper and one replete with interesting information."

"There is no paper I read with such profound interest as the Scientific American."

"It is the most valuable up-to-date scientific publication of its kind published. Its articles are always fresh and reliable, and written in such a popular style as to be easily comprehended by even the layman in scientific matters."

"I regard the Scientific American as decidedly the best scientific paper published in America."

"No paper which comes to my hands contains more information of a kind that is of practical use to legislators."

"I have been a constant reader of the Scientific American for many years, and find that it keeps pace with the growth of the country and the development of knowledge and ideas."

Several Senators write:

"It has no equal in the journalistic world."

The following comments have recently been received from some of our old friends:

"I have subscribed for your paper for over forty-eight years and have not missed a copy, and would not be without it."

"Please find renewal of subscription to the Scientific American for W. A. P., Rutland, Vt., who has been a subscriber for over forty years. Is he the oldest subscriber?

"I have nearly complete volumes of the Scientific American for some thirty-five years and consider myself a life member."

"Please renew my subscription to the Scientific American. I cannot afford to be without it, as it has become a part of my life. A perfect library, up to date every week."

"I have taken the Scientific American for the last twenty-five years and have every paper up to last Saturday. I would not think I could do without it. I think it is the best paper published in the world."

"For more than twenty-five years I have taken your interesting and valuable paper and probably shall continue as long as I live, and I wish that every young man could be a constant reader of it."

"Your paper is a grand instructor for any young man, and I would not be in want of it and the Supplement for $20 per year, as everything in the papers is good, moral and instructive."

"After being a reader of the Scientific American for about thirty-six years, and having near forty-five volumes, which I consider is a valuable encyclopedia for mechanics, I would be at a loss to place a value upon them. My boy will subscribe for 1900, and I will close my subscription for the paper, hoping that he will be a reader as long, or longer, than I have been, and receive as much benefit as others have. I take this opportunity to thank you for what knowledge I have received from reading them, and in ceasing to be a subscriber to say if I had the ear of all young mechanics I would urge them to read your paper first of all others."

The late Vice-President Hobart wrote some time ago: "I shall derive much profit from the paper."

The United States Commissioner of Education writes: "The Scientific American is a newspaper that I have always taken a delight in ever since I first began to read it as a boy on a farm in Connecticut. I never let a week's issue of it go by without examining it and finding things of interest in it."

Recent Balloon Ascensions Near Paris.

MM. Gustave Hermite and Maurice Farman have presented to the Académie des Sciences an account of a successful and important balloon ascension carried out by them on the 16th of September last. The ascension is described by the aeronauts as follows:

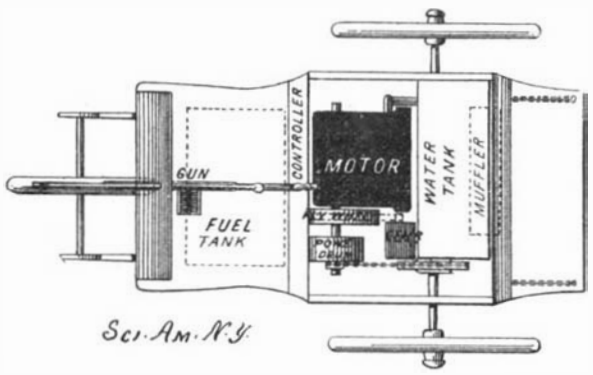
"The start was made from the gasworks, near Paris, at 6:25 in the evening, and a maximum height of 4,700 meters was attained, as indicated by our registering barometer of the Richard type, which worked perfectly, and was calibrated before and after the ascension by the Meteorological Bureau of Paris. After passing over the south of France, the descent was made on the borders of the Mediterranean, near the Gulf of Fos, after having remained fifteen hours in the air. The horizontal distance covered was about 655 kilometers. Our instruments included a registering barometer, thermometer, and hygrometer combined, also a second registering barometer, besides compasses, photographic apparatus, electric lamps, etc. A part of the ballast was made up of printed indication-sheets, which were classed and numbered. These we sowed along the route during the voyage at stated intervals. Of these sheets, many were sent back by post by the persons who found them, and thus we are able to reconstruct not only our route, but also the variations in horizontal speed. We left in a rather strong northeast wind, making 60 kilometers during the first hour. The direction, southeast, was not varied during the night, but the speed diminished gradually until morning, it being then 16 kilometers per hour. We were constantly surrounded by enormous clouds, but did not receive rain. We saw the earth at times through the rare openings in the clouds, and the moon permitted us to observe several optical phenomena, such as a lunar rainbow entirely colorless, which appeared for a few instants on our left and a little below us about 8 o'clock in the evening. Another phenomenon observed was that of the shadow of the balloon, projected upon the clouds and surrounded by a kind of halo, also colorless.

"The humidity, contrary to the general law, increased with the altitude and attained an approximative saturation at 2,800 meters, this height being reached a little before daybreak. The thermometer showed —5° C. At this time we were going directly south, and our speed, slow at first, became greater upon encountering a new air current, which a few hundred kilometers further south became a violent wind. It is at this point that we perceived a trumpet-shaped cloud, which enveloped us with a circular motion, and the equilibrium of the balloon was greatly compromised. We supposed that the circular motion was caused by the encounter of two currents of air. Having descended at 5h. 52m. in the morning to 900 meters, we recognized the country of Dombes, 45 kilometers to the north of Lyons, and there we received a few drops of rain. The balloon then commenced to mount toward the region of high altitude, and we passed above the clouds and saw the marvelous spectacle of an undulating sea of clouds, from which emerged, at a great distance, the principal summits of the Alps. Mont Blanc thus served us as a guide for a long time. At 4,100 meters we traversed a kind of ice-cloud, composed of microscopic crystals, which deposited themselves upon us with a peculiar crackling sound. Here the thermometer showed —7° and the hygrometer 40. Below us was a light rain. We saw also a rare phenomenon, that of the sun's image reflected from the clouds, which thus acted as a mirror.

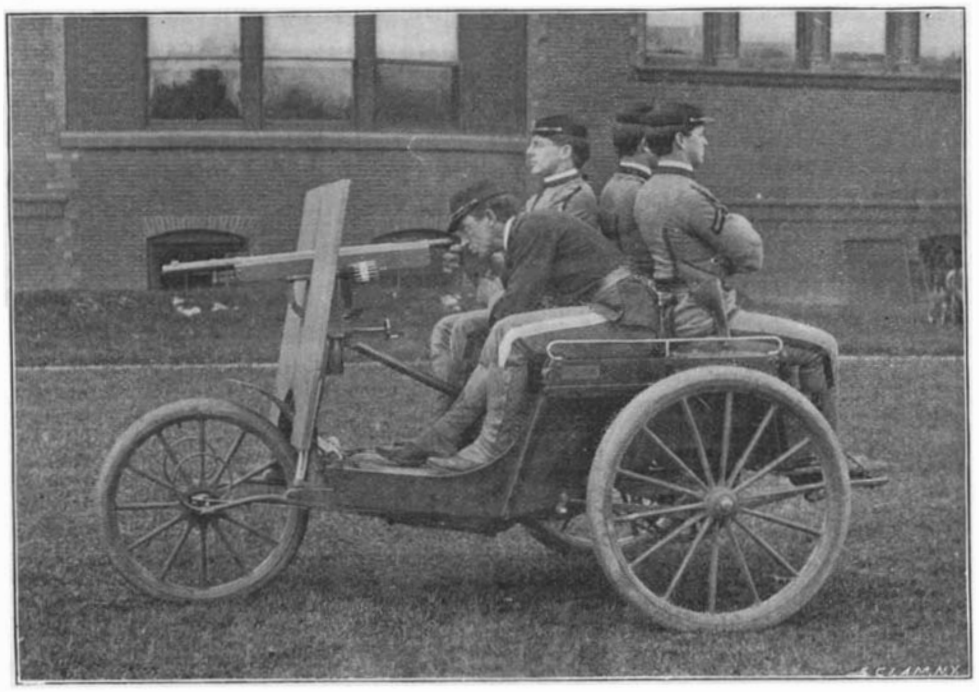
"Following the left bank of the Rhone, the clouds dispersed by degrees, being swept by the Mistral wind and carried back upon the mountains. Below us opened a transparent gulf, at the bottom of which we saw pass, at lightning speed, the towns of Valence, Montelimar, Orange, etc. At 9h. 12m., being then above Avignon, we came in sight of the Mediterranean. (Barometric altitude, 4,700 meters; thermometer, —10°; hygrometer, 26.) We allowed the balloon to descend, and felt a strong wind. At 1,500 meters the wind whistled violently, and at 9:33 we took earth in the great plain of the Crau, after some terrible shocks. We had made 130 kilometers per hour since leaving Avignon, and near the earth the speed was undoubtedly much greater. The successful landing under such perilous circumstances was due in great measure to the accessories which were specially constructed for the purpose. The diagrams which we obtained with our registering instruments are very clear and show a decrease of temperature of 1° for every 185 meters. The working of the hygrometer was normal during the day. We also took some photographs in the high regions."

MILITARY MOTOR CARRIAGE.

We have been favored by Major R. P. Davidson, of the Northwestern Military Academy, of Highland Park, Ill., with a photograph of the military motor carriage, designed by him. It was built by the Peoria Rubber and Motor Vehicle Company, of Peoria, Ill., on the Duryea plan. The gun carriage is driven by gasoline. It weighs, with gun and full equipment, 1,100 pounds. The wheels are 36 inches in diameter and are provided with wooden spokes and pneumatic tires. The fuel tank is in front and furnishes gasoline to the 6-horse power Duryea three-cylinder engine, which has a fly-wheel 16 inches in diameter. There is a single feed-pipe and an exhaust pipe, and a single set of cam shaft gears which operates all the valves and igniters. The location of the various parts will be seen by reference to our diagram. The carriage has a windlass attachment, and by fastening a rope to it and anchoring the end of the rope, the carriage can pull itself out of holes or up steep grades. The tank holds enough gasoline for a run of 200 miles, and it seats four persons with tents, blankets, equipment, extra supplies, rations for a week or ten days, and 4,000 rounds of ammunition for the 7-mm. Colt automatic rapid-fire gun which fires 480 shots a minute. The gun has a range of 180 degrees and the firing range of the gun is over 2,000 yards. A detachable bullet-proof shield protects the operator, and the tank and machinery are also made bullet proof. It is Major Davidson's intention to ascertain what the carriage can do on good roads, rough roads and over plowed fields. It will be taken to Washington in the spring and exhibited at the Ordnance Bureau. Major Davidson has given the matter five years of thought.



PLAN OF GASOLINE GUN-CARRIAGE.



MAJOR DAVIDSON'S MOTOR MACHINE-GUN CARRIAGE.

Production of Alcohol from Plants.

A number of interesting experiments have been recently made by M. V. Kuess as to the production of alcohol from plants. He finds that certain plants may be used to produce alcohol in profitable quantities and may thus afford an important source of supply. The plants best adapted for the purpose are the scilla (squill), the asphodel, and the alfa. The former is well known as a medicinal plant; it is interesting to observe, however, that the alcohol obtained from it does not contain any traces of the active principle which gives to the plant its medicinal properties. It is estimated that by proper treatment at least 25 per cent of alcohol may be obtained from this plant. The asphodel furnishes equally 25 per cent of its weight of alcohol, which possesses all the properties of the alcohol obtained from spirits, and besides a residue is left which does not contain injurious matter and may be used as food for animals. The alfa is a plant which is very abundant in the south of France and in the north of Africa, and from this source may be obtained not only alcohol, but also a fibrous matter which may be utilized for the production of paper paste or textile fibers. The experimenter finds that 100 kilogrammes of the plant will give 14 liters of alcohol and 60 kilogrammes of paper paste, or, by another treatment, 10 kilogrammes of textile fibers. The production of paper paste from this plant has been carried on for some time, and it has been known also that the plant gives fibers long enough for the production of tissues, but M. Kuess seems to have been the first to make known its value as a source of alcohol, while at the same time the production of the paper paste is not interfered with. He considers that it is the gum and the cellulose of the plant which furnish the alcohol by their fermentation. To separate these substances from the fibers, the plant is crushed in a mill and acidulated water added; the mixture is heated in a boiler, and during the operation the mass is traversed by an electric current. By this means the gum, cellulose, and coloring matter enter into solution; this is filtered and transferred to the fermenting vats. At the end of three days the fermented liquid is distilled and an alcohol of 45 per cent strength is obtained; this has at first a disagreeable odor, but the experimenter, by designing a special distilling apparatus, has succeeded in rectifying it to a point where no odor or taste is appreciable. The residue of the filtration is transformed into paper paste. If it is wished to obtain textile fibers, the plant is at first pressed between rollers, in place of grinding it, and is afterward treated by electrolysis in sea water. The alcohol obtained from the three plants above mentioned has the great advantage of containing neither acid nor ether, and may thus be directly employed in the different industries.

The Psychology of Fishes.

Numerous facts witness in a vague way to the ability of fishes to profit by experience and fit their behavior to situations unprovided for by their innate nervous equipment. All the phenomena shown by fishes as the result of taming are, of course, of this sort, but such facts have not been exact enough, says Mr. Edward Thorndike in The American Naturalist, to make clear mental or nervous processes involved in such behavior, or simple enough to be available as demonstrations of such processes. Through the kindness of the officials of the United States Fish Commission at Wood's Holl, he was able to test the efficiency of some simple experiments directed toward this end.

The common fundulus was chosen and the fish was kept in an aquarium. The space at one end was shaded from the sun by a cover, and all food was dropped in at this end. Along each side of the aquarium were fastened pairs of cleats, allowing the experimenter to put across it partitions of wood, glass or wire screening. These partitions were made each with an opening at some part, and then the experiments were begun. When the fish was caused to leave a shady corner and swim up the sunny end by putting the slide without any opening in behind him, and moving it gently up toward the forward end, the opportunity was given for observing the animal's behavior to good purpose.

This fish dislikes the sunlight, and tried to go back to the shaded portion. He swam against the screen, bumping against it here and there along the bottom; occasionally he stopped and remained still for a while. Sometimes he would rise up toward the top of the water, especially while swimming up and down the length of the screen. The screen used in the first experiment was cut away slightly at the upper corner so as to leave an opening, so that the slide somewhat resembled a letter with a postage stamp on it, the postage stamp representing the aperture. After the fish had been experimented upon six or eight times a day, it was found it swam against the screen less and less. He swam up and down it fewer and fewer times until finally his only act was to go to the right hand side, rise up and swim out. The fish had clearly profited by his experience and modified his conduct to suit his situation, for which his innate nervous equipment did not definitely provide. He had, in common language, learned to get out.

James Hamblet.

James Hamblet died on January 2, aged seventy-five years. He was one of the pioneer electrical manufacturers, and in 1878 he organized the time service for the Western Union Telegraph Company. He introduced a large number of improvements into the electrical distribution of time.

The Rapid Decline of Geyser Activity in Yellowstone Park.*

BY PROF. E. H. BARBOUR, OF THE UNIVERSITY OF NEBRASKA.

We would avoid posing as alarmists respecting the decline of geyser activity in the Yellowstone National Park, but nevertheless, if the present apparent rate of decline continues, it seems likely that within a decade many of the scenes which attract us most will have disappeared. The naturalist should visit this spot at once. It was my privilege to visit the National Park on August 5, 1895, and again August 5, 1899, and certainly the evidence of change during these short years seems startling. To the geologist the change is serious and impressive. It may be said in a general way that there is an apparent decline of geyser phenomena everywhere throughout the Park.

Or such is the impression of myself and others, if impressions are reliable. Furthermore, it is the impression of frequenters of the Park, especially those who visit it annually, that the decline of geyser phenomena there is greater than is realized by the people at large. So much for a general statement.

To be more specific, without entering into many details, it may be stated that around the splendid terraces at the Mammoth Hot Springs, buildings now stand where there was steaming water in 1885. Spots which we photographed in 1895, standing shoe soles in water, are now either dry or nearly so. Minerva Terrace, which was boiling and which presented a fine array of geyserite in 1895, is falling into decay. Large blocks of the "formation" are falling from the rims and sides of the basins. To the eye the amount of water which flows over Pulpit Terrace and Jupiter Terrace is noticeably less.

We should say not one-half what it was four years before. The lattice work, constructed for the purpose of spraying and incrusting curios, was changed to a new spot where water was still flowing. The narrow gage, which may be called a fissure vent, though still showing life, is extinct as compared with conditions four years ago. Roaring Mountain is still steaming, though silent. In the Norris Geyser basin the most obvious change is in the Black Growler, which formerly emitted volumes of steam from an oblique vent by the roadside. The steam jet is now divided and the volume of steam and its roar and display of energy greatly diminished. The Fountain Geyser, which was such a favorite that the Fountain Hotel was located at that spot, is now wholly extinct, and tourists are complaining because they must waste time stopping at this hotel. The Fountain has been replaced by a new but very inferior substitute named the Dewey Geyser. Tourists do not care to wait to see it in eruption. The giant paint pots are now so contracted in size that one can walk over what was a short time ago boiling mud. The red half is extinct; the white half active, though reduced in area. In the Upper Basin there is evidence on all sides of activity, but with many changes since 1895. Then the Splendid Geyser was attracting attention. Now it is silent and considered extinct. It is replaced by the Daisy Geyser, an interesting but vastly inferior substitute. The Cascade Geyser, another favorite because of the frequency of its eruptions (about every 15 minutes), has dropped to an eruption interval of once every 24 hours.

The Grand Geyser, which used to erupt once a day, has been active but three or four times the past season, according to all accounts. The Beehive Geyser, active in 1895, is supposed to be wholly extinct. Old Faithful seems as fine as ever, but the interval of eruption is now about 75 or 80 minutes instead of once an hour. If it is possible to judge fairly of such matters, there seems to be increasing activity in the ebullition of the water in that greatest of geysers, the Excelsior, which leads to a feeble hope that it may possibly be rejuvenated yet once again. In this connection may be mentioned the apparent increase in the activity of the Mud Geyser, by the thumb. The mud, which in 1895 was thick, and thrown up in large masses but a few feet, is now thinned and ejected as far as the road, a distance probably not far from 200 feet. At first thought it seems like increased activity, yet it may possibly be accounted for on the ground that the mud is in a condition making more active ejectment possible. A great quantity of mud has been thrown out recently, as much as 8 to 10 feet thick, and the trunks and boughs of the neighboring pines are loaded and weighed down with mud. Trunks were noted where the coating of mud, half way up to top, exceeded 6 inches. The front half of the crater is now built up symmetrically with the other side, making a very regular funnel-shaped crater about 100 feet across, and some 25 or 30 feet deep. Below, the mud is in a state of constant and active ebullition. Possibly this case may be construed as a case of increasing activity; however, on the whole it is only too obvious that there is a serious decline, as one can see by observation, and can learn by consulation with the drivers, guides, tourists and officers at the barracks. It was the testimony of all that the changes were much more rapid than is understood, and our closing admonition is, visit the National Park at once.

*An address delivered August 25, 1899, at the Ohio State University, Columbus, O., before the Geological Section of the American Association for the Advancement of Science. Revised by the author especially for the SCIENTIFIC AMERICAN.

The Current Supplement.

The current SUPPLEMENT, No. 1256, is of great interest. "Mechanical Traction on Canals" is the title of an important article, and "Towing Canal Boats by Electricity" describes a curious trolley system in which the motor runs on rails along the tow-path and receives its current from a trolley. "The New Smokeless-Powder Guns of the United States Navy" gives important tables. "Homemade Windmills of Nebraska" is concluded, and the Holland mill, the stationary turbines, vaneless turbines and mock turbines are described. It is accompanied by thirteen interesting engravings showing in detail the construction of these important windmills. "Competition for the Best Life Saving Device in Cases of Disaster at Sea" gives the official regulations which have been adopted in regard to the Anthony Pollok Memorial Prize. "The Pan-American Exposition of 1901" is accompanied by four large illustrations, and there is also an article on the buildings. The Exposition is going to be an important one, and will doubtless be visited by hundreds of thousands from all over the country.

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RECENTLY PATENTED INVENTIONS.

Bicycle-Appliances.

DEVICE FOR MENDING PNEUMATIC TIRES.—EDMOND ISBILLS, Bayonne, N. J. The device comprises practically three parts: a guide-cup, a fixing-needle, and a cementing-needle. The fixing-needle is employed for securing the guide-cup in the tire; and cement is introduced by means of the cementing-needle. When the device is withdrawn from the tire, the puncture will be immediately filled with cement, the body of which will be left in the form of a cap or head adhering to the inner surface of the tire around and over the puncture. The tire can be inflated immediately after the cement has been placed in position, the air drying the cement and forcing it into better contact with the tire.

Agricultural Implements.

CHURN.—JOHN J. JONES, Braman, Oklahoma Territory. The inventor supports the cream receptacle or body of the churn in a light frame hung from a crank-shaft, which, being rotated, imparts a reciprocatory and oscillatory movement to the body and thus quickly separates the butter from the other constituents of the cream.

CULTIVATOR.—HENRY C. BOTHWELL, McArthur, Ohio. This manually-operated cultivator comprises a frame carrying cultivating devices, a draft-bar secured to the frame and having points for a draft, which points extend rearwardly of the front cultivating devices and at an oblique angle to the face of the frame. The resistance to be overcome at the points of the teeth being greater than the gravity of the implement at these points, the implement will have a tendency to rise at the rear and revolve forward on its front teeth. The operator overcomes this tendency to revolve by lightly bearing downward on the handles, thus embedding the teeth the required depth. As the implement is drawn ahead, the teeth will regularly act upon the soil; and the draft will be exceedingly light.

Engineering-Improvements.

SLIDE-VALVE.—ILA N. MOORE, Battle Creek, Mich. Often when a steam-pump is doing heavy work, the piston and valve travel are shorter than when the pump is doing light work. Hence less steam is admitted at a time when more steam is required But when the load is reduced, the stroke increases and more steam is admitted than is necessary. To overcome this difficuliy and to admit a proper amount of steam, the inventor uses a slide-valve provided with extended wings for covering at all times the admission-ports to the cylinder. The wings are provided with ports designed to register with the admission-ports on either a short or a long stroke of the valve, the ports on one of the wings being of a different area from those on the other wing.

WATER TUBE BOILER.—TOM FRENCH, Andover, Me. The boiler comprises spaced mud-drums above which are spaced steam-drums. A set of transverse water-circulating pipes lead from a mud-drum on one side to the steam drum on the opposite side. The pipes of the sets alternate and are arranged close together at their point of crossing to form a solid roof for the fire-box. A very large heating-surface is provided to insure a quick generation of steam, especially as the circulation of the water from the mud to the steam drums is comparatively quick; and the heat from the fuel in the fire-box is caused to circulate in the shell to give off its heat, before it finally passes to the smokestack.

Mechanical Devices.

COFFEE OR MALT DRIER.—FRITZ E. R. OKRASSA, Antigua, Guatemala. This drying-machine comprises a rotary drum provided with means for the admission and escape of the drying agent. Stirrers are held to rotate with the drum and are provided with apertures for the introduction of the material. Slides or doors close the apertures. By the improved construction of drying-compartments, and particularly by the specific arrangement of the stirrers, the drying-compartments can be filled about four-fifths, thus securing an exceedingly thorough utilization of the available space.

COTTON-ELEVATOR.—GEORGE W. WILLIAMS, Waco, Tex. The cotton-elevator is pneumatically-operated and is composed of an air-airculating apparatus and a number of boxes each having an air-conduit and a cotton-conduit. The cotton-conduit communicates directly with the main portion of the box into which the cotton is discharged. The air-conduit has a lateral extension at each end, communicating with the box directly adjacent to the cotton-conduit. The air drawn into the air-conduit passes from both ends of the cotton-conduit, thereby establishing cross-currents to deliver the cotton into the body of the box.

CORSET-FASTENER.—MARY O. ROSS, Carlinville, Ill. The Ross Corset Fastener is made very thin, with a smooth surface, and will not show through the dress, or catch upon or wear through the most delicate undergarment. When the corset is once fastened it will not open in any position or under any strain, until the ear of the fastener is pressed for that purpose. The fastener is hence especially adapted to the needs of girls in schools and factories, and to the wants of all other women whose occupations require freedom of the body, but who still desire the support of a corset. Being firmly fastened, the unpleasant snapping which characterizes the old style of fasteners is entirely obviated.

MAGAZINE PENCIL.—GEORGE W. RICE and GUSTAV ZERRMANN, Brooklyn, New York city. Within a suitable casing is placed a magazine which may be adapted for holding any number of leads. The magazine may be turned to bring any one of the leads desired into registry with an opening near one side of the casing. The end of the casing is beveled toward this opening, so that a larger blunt end of the casing is not brought near the point to interfere with the use of the pencil.

Miscellaneous Inventions.

PUMP.—ALVA L. REYNOLDS. Santa Ana, Cal. The object of the invention is to provide a well pump which acts on the vacuum principle and which after once being started will continue in operation without further attention. The pump comprises a vacuum-cylinder having a valve-controlled inlet and outlet. A float is arranged in the cylinder and likewise an oil-pump operatively connected with the float. An oil-receiver in the cylinder contains gasoline which can be ignited electrically, the successive explosions of which discharge the air, creating a vacuum and causing the water to rise.

COMBINATION STEP-LADDER.—WALTER L. SKELLEY, Cabool, Mo. The invention provides a combination long and step ladder, the sides of which when used as a long or extended ladder constitute each a truss and the hinges central struts, rendering the extended ladder exceedingly stable. The platform and connected parts may be utilized to lock and brace the sections when these sections are brought end to end to form a continuous or long ladder. The ladder can be quickly converted from one form to the other.

HAT-FASTENER.—GEORGES SCHMITT, Manhattan, New York city. This fastener is a simple and efficient device comprising a pin of novel construction which is adapted to be engaged with the hair of the wearer. When the pin is forced in position, loops are pushed into the hair so that the hat cannot be blown off.

BOX.—JOSEPH V. OTTEN, Iola, Kans. The inventor's purpose has been to provide a cover with a simple means for attachment to and detachment from a box designed to hold carbonated beverages. The cover consists of two sections, the inner or adjacent ends of which are connected by springs. Lugs on the outer ends of the section engage perforations formed in upright portions of the box. When the sections of the cover are in horizontal position, the springs will cause them to remain in this position, because the tendency of the springs is to force the inner ends of the cover sections downward.

COMPOSITION FOR CLEARING SUGAR.—EDWIN L. MCTYRE, Thomasville, Ga. The composition for clarifying brown or crude cane-sugar consists, of clay, chopped corn-husks, and water. A spongy batter is formed which retains its moisture long enough to extract the impurities from the sugar and leaves the sugar clear in the trough. The batter can be very cheaply manufactured and applied without danger of the clay's intermingling with the sugar in the trough.

CONVERTIBLE TUB.—MRS. NELLIE F. HURDEL, Manhattan, New York city. This is an ingenious invention for converting a bath-tub into a laundry-tub. Removable partitions are employed, provided with a pneumatic packing which not only makes a tight connection between the partition and the tub, but is self-sustained on the partition, so that no wires or screws are required to hold it in place. Should the lower stretch of the packing become worn, it may be turned upon the partition to bring the upper stretch across the lower portion of the partition.

DEVICE FOR CONNECTING SHAFTS WITH OTHER PARTS.—FRANK E. HAWKSWORTH, Helena, Mont. The purpose of the present invention is to provide a device for attaching a cam or pulley to a shaft, which device is so constructed that when the cam or pulley is driven in a proper direction it will remain fast on the shaft, and when driven in a reverse direction may be quickly loosened from the shaft. The device supersedes the pins commonly employed, which are so liable to fall out or be sheared off.

MOTOR-CYCLE FRAME.—TOM FRENCH, Andover, Me. Reaches have ball-and-socket connections with the front and rear axles, and a frame has ball-and-socket connection with the rear axle and a longitudinal sliding connection with the front axle. The frame, therefore, yields, when the vehicle-wheels pass over rough roads, to insure easy riding to the occupants of the vehicle and to allow the driving gear to work properly and true at all times.

SHIRT.—SIMON ELBAUM, Wilkes-Barre, Penn. The shirt or like garment is provided with a reinforce or yoke extended over the shoulders both back and front and also extended entirely around the sleeves for a portion of their length.

DEVICE FOR FASTENING SHOES.—MICHAEL M. DOOLEY, Loogootee, Ind. The object of the invention is to provide a means for fastening shoes or for uniting the front sections of the uppers without using a lace or means liable to break. The shoes can be secured upon the feet more quickly than by the ordinary means and the front opening better protected.

FILLING-CAN.—WILLIAM L. CLAYTON and NEWTON R. PERSINGER, Central City, Neb. This device for filling lamps with oil from an oil-can or from a barrel comprises a screw-cap in which a delivery-pipe is secured, projecting above and below the cap. A spout is mounted to turn on the outer end of the pipe. An extension-pipe slides on the inner end of the delivery-pipe; and a T-shaped air-pipe is secured in the cap alongside the delivery-pipe, with its horizontal member above the cap. An air-bulb or bellows is connected with one end of the horizontal member of the air-pipe; and a removable cap is provided for the other end.

COMBINED ASH-BOX AND SHOVEL.—WILLIAM S. ANDERSON, Jasper, Tenn. This combined ash-box and shovel consists of a box having one side hinged to drop downward and adapted to act as a shovel. The side edges of this side have integral, up-turned flanges. Pivoted links connect the box and shovel and limit the outward swing of the shovel.

TOBACCO-BASKET.—GEORGE P. SUGG, St. Lewis, N. C. This basket is of rectangular shape and comprises a flexible bag or body portion and diagonally-arranged and pivoted spring-bars anchored at their ends to the angular corners of the bag, whereby the folding of the basket will cause the spring-bars to move radially to a less distance from the center than they occupied when distending the corners of the body portion or bag.

SHIPPING CRATE FOR EGGS, BOTTLES, ETC.—ROBERT I STEWART, Xenia, Ohio. The inventor provides a cushioning body of stiff paper or pasteboard, having its folds so bent or lapped as to give unusual elasticity to protect the contents of the casing, package, or box. No special means are required to hold the folds down. The laps have an abutment or seat-portion bearing to receive the edges of the fillers or division seats forming the compartments of the crate and thereby render the whole structure stable in character.

ACETYLENE-GENERATOR.—WILLIAM F. COOPER, Meriden, Conn. This acetylene-generator has a water-reservoir in the base with a contracted mouth having a screw connection. A carbid-holder in the top has a correspondingly-contracted lower end with screw connection and is covered by a gasometer and connected therewith by a flexible fabric. A valve is mounted in the water-chamber below the bottom of the carbid-holder; and an adjustable rod fixed eccentrically to the gasometer, passes through the carbid-holder, and is adapted to open the valve and feed a fresh supply of carbid upon depression of the gasometer.

SHELVING.—JAMES M. LIPPINCOTT, Oakland, Ill. The improved shelving devised by this inventor comprises a shelving-section movable vertically to a height above the ordinary fixed shelving. The section is then

adjusted laterally back above the fixed shelving, thus utilizing the space above the fixed shelving and permitting the movable shelving-section to be conveniently brought within reach.

TOOL-HOLDER.—GEORGE R. SHERWOOD, Kearney, Neb. A suitable framing, clamping devices acting in conjunction with a base-block and a crown-block, the outer surfaces of which are convex and the inner surfaces flat, permit the adjustment of the tool to any angle and enable it to be clamped between the block surfaces in any desired position. The clamping devices are arranged to bind the tool between the base and crown blocks, the convex form of the outer sides of which blocks enable the blocks to rock to secure the desired adjustment of the tool.

GRAIN-CLEANER.—GEORGE L. BEADELL, Chicago, Ill. The cleaner comprises a box having a hopper at its upper end and containing a swinging hinged rougher extending in an inclined position and discharging the coarse material through an opening in the casing to the outside. A swinging hinged separator below the rougher and inclined in an opposite direction receives the material passing through the rougher. Screens arranged in zigzag manner below the separator receive the material. Deflectors spaced from the wall of the casing deflect the material from one screen to the other, the material passing from the lower end of the separator being discharged between the deflectors and the wall of the box.

Designs.

GAS-COCK.—ANDREW J. WIEGAND, Baltimore, Md. The design patent granted to Mr. Wiegand is for a self-lighting gas burner of novel design, having a main passage for the gas to the burner-tip, a perforated holder for platinum-sponge adjacent to the burner-tip, and a valve which controls the passage of gas to the main burner-tip or to the platinum-sponge so the gas may be ignited at the main tip from the platinum-sponge and the passage of gas to the platinum-sponge will be cut off after the gas has been ignited at the burner-tip.

VIOLIN-BODY. — ELIZA A. R. KITCHEN, Monroe, Ohio. The violin has a body partly heart-shaped, partly star-shaped, and an anchor-shaped head.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS ETC

PENROSE'S PICTORIAL ANNUAL. THE PROCESS YEAR BOOK FOR 1899. Edited by William Gamble. London: Penrose & Company. 1899. 8vo. Pp. 108.

Process reproductions have almost entirely displaced all other methods of reproducing pictures, and while much has been lost, much has also been gained. At present there does not seem to be any limitation to process work, and the results as outlined in this Annual are wonderful. Some of the half-tones are very remarkable, and the color work is scarcely less so.

AMERICAN ANNUAL OF PHOTOGRAPHY AND PHOTOGRAPHIC TIMES ALMANAC FOR 1900. New York: The Scoville & Adams Company. 1899. 8vo. Pp. 370. Illustrated. Paper 75 cents.

The present volume is ably edited by Mr. Walter E. Woodbury and is the fourteenth of the series. It is filled with valuable articles and it is profusely illustrated. It strikes us as being the best annual we have seen and no photographer can afford to be without it.

METAL AND PLATE WORK. Its Patterns and Their Geometry; also Notes on Metals and Rules of Mensuration for the Use of Tin, Iron and Zinc Plate Workers, Coppersmiths, etc. By Charles Millis, M.I.M.E. London and New York: Spon & Chamberlain. 1899. 12mo. Pp. 456. Price $3.50.

This is an excellent book upon an eminently practical subject. Probably no trade requires such a comprehensive knowledge of geometry as metal plate work, and this book is calculated to give exactly the information which is needed by practical men. The methodical part of it is not neglected, but it is merged in the practical. It is an admirable book and is a complete treatise upon the subject.

STAR NAMES AND THEIR MEANINGS. By Richard Hinckley Allen. New York: G. E. Stechert. 1899. 8vo. Pp. 563. Price $5.

This list of star names is published in the endeavor to fill an acknowledged vacancy in our astronomical literature. It is not intended for the professional astronomer, who, as a rule, cares little about the old designations of the objects of his study, yet great scholars have thought this nomenclature not unworthy of their attention. The author has accomplished a most difficult task with rare discrimination and success. The work is most scholarly and reflects the highest possible credit upon the learning of its author. Very few men could have written this book, which is most beautifully printed by the DeVinne Press. It will certainly tend to foster a more intelligent interest in the nomenclature of practical astronomy, and the author should be well pleased with the result of his arduous labors.

MATHEMATICS. New York: Doubleday & McClure Company. 1899. 12mo. Pp. 340. Price $1 net.

This book is essentially practical, and is intended for young men and others who wish to obtain such a knowledge of mathematics as should be of service to them in their business as mechanics or engineers, and to obtain it by study at home. The bulk of the material was issued in The Chicago Record, and proved to be of the utmost interest and value. After a careful examination of the book, we are inclined to believe that the problems proposed are much more practical than in the stereotyped textbooks of mathematics.

Business and Personal.

The charge for insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

Marine Iron Works. Chicago. Catalogue free.

For hoisting engines. J. S. Mundy, Newark, N. J.

"U. S." Metal Polish. Indianapolis. Samples free.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

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The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated: correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7815) A. J. W. asks: Can you give me the formula for government whitewash? A. The following coating for rough brick walls is used by the United States government for painting lighthouses, and it effectually prevents moisture from striking through. Take of fresh Rosendale cement, 3 parts, and of clean fine sand, 1 part; mix with fresh water thoroughly. This gives a gray or granite color, dark or light, according to the color of the cement. If brick color is desired, add enough Venetian red to the mixture to produce the color. If a very light color is desired, lime may be used with the cement and sand. Care must be taken to have all the ingredients well mixed together. In applying the wash, the wall must be wet with clean fresh water; then follow immediately with the cement wash. This prevents the bricks from absorbing the water from the wash too rapidly, and gives time for the cement to set. The wash must be well stirred during the application. The mixture is to be made as thick as can be applied conveniently with a whitewash brush. It is admirably suited for brickwork, fences, etc., but it cannot be used to advantage over paint or whitewash.

(7816) J. K. asks: 1. How much wire and what size would be sufficient to wind the voltmeter described in SUPPLEMENT, No. 1215, to register no higher than 75 volts? A. The same winding may be used for reading to 75 volts as to 110 volts. The scale will be shorter for 75 volts. 2. How many gallons of nickel solution will the plating dynamo described in "Experimental Science" plate? A. The machine is not to be rated by gallons. It will plate small articles, whether in much or little liquid. 3. What is a receipt for nickel solution or how is it made? A. For solutions to be used in plating see Van Horne's Electro-Plating. Price $1, by mail.

(7817) M. P. asks: What size wire should be wound on a dynamo, the armature of which is 2 inches in diameter and 4 inches long? The F. M. is 6½ inches high and 4 inches wide? A. No definite answer can be given to a question of this sort. To answer it one should have measurements so that a correct and complete drawing of the machine could be made from them, not simply one or two dimensions. The best we can say is, use any number between 24 and 30. You will get something.

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AND EACH BEARING THAT DATE.

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Back Page, each insertion, - - $1.00 a line

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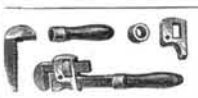

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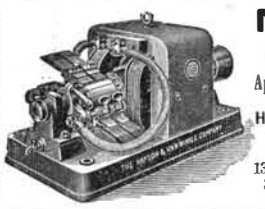

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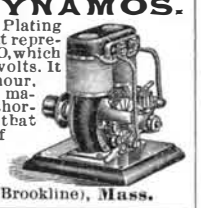

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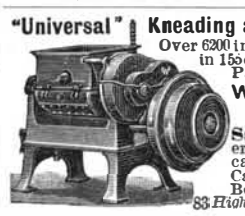

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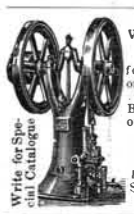

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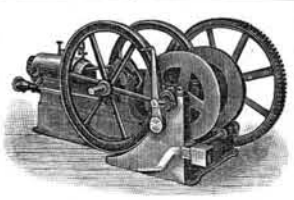

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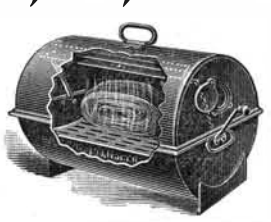

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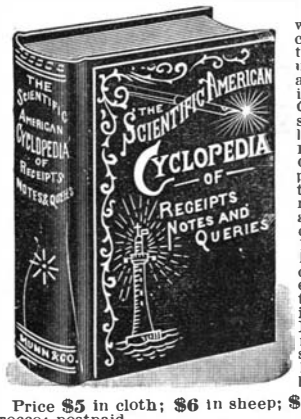

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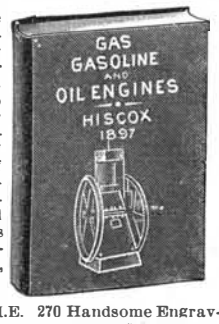

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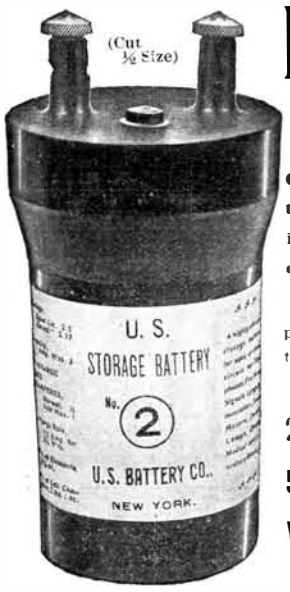

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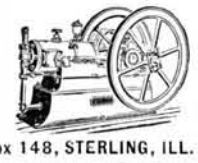

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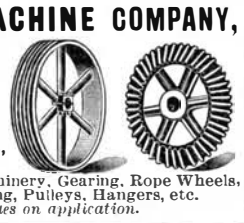

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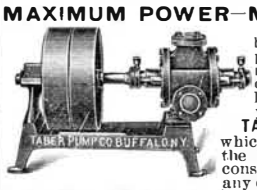

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